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PROTECTION AND MANAGEMENT OF LAND RESOURCES; COMBATTING DESERTIFICATION AND DROUGHT

Report of the Secretary-General of the Conference

I. INTRODUCTION

1. The Preparatory Committee in its decision 1/15 on Soil Loss and Desertification and Drought, Section II - Desertification and Drought:

(a) Invited the United Nations Environment Programme to implement urgently the provisions of paragraphs 6 and 7 of General Assembly resolution 44/172 A of 19 December 1989, and 44/172 B related to the progress achieved in the implementation of the Plan of Action to Combat Desertification;

(b) Requested the Secretary-General of the United Nations Conference on Environment and Development, in consultation with the United Nations Development Programme, the United Nations Environment Programme, the United Nations Sudano-Sahelian Office, the World Bank, the International Fund for Agricultural development, the Food and Agriculture Organization of the United Nations, the United Nations Educational, Cultural and Scientific Organization and other appropriate regional, intergovernmental and non-governmental organizations to report to the Preparatory Committee at its third session on the results achieved, the control measures applied and the financial and technical support given in the implementation of the Plan of Action to Combat 8Desertification and the need for further international cooperation that might be required in combating drought and desertification;

(c) Invited the United Nations Environment Programme, in collaboration with relevant organizations of the United Nations system, to initiate work on the monitoring, assessment and implementation of the control measures in the Plan of Action to Combat Desertification;

(d) Requested the Secretary-General of the United Nations Conference on Environment and Development to follow closely the drought monitoring and research activities currently being undertaken by the World Meteorological Organization, the United Nations Environment Programme, the United Nations Sudano-Sahelian Office, the Food and Agriculture Organization of the United Nations and other relevant organizations, inter alia, the Sahel-Sahara Observatory and to report to the Preparatory committee at its third session on the status of such activities and make recommendations on how the Preparatory Committee could support those very important initiatives;

(e) Also requested the Secretary-General of the United Nations Conference on Environment and Development to prepare a comprehensive study on ways and means of expanding reforestation activities to combat land degradation and desertification.

2. In addition, the Preparatory Committee, in its decision 2/11 on Protection and Management of Land Resources:

(a) Noted with satisfaction the report of the Secretary General of the Conference on the Protection and Management of Land Resources (A/CONF.151/PC/25) and welcomed the proposals for the development of alternatives sustainable systems of production;

(b) Requested with satisfaction the report of the Secretary-General of the Conference to develop these proposals in greater depth for the third session of the Preparatory Committee, paying particular attention to: (i) developmental aspects; (ii) economic and social dimensions including land tenure; (iii) resources and financial aspects; and (iv) popular participation and in particular the participation of women;

3. The present report was prepared by the Secretariat in response to the requests outlined in paragraph (b). In answering the other requests of the Preparatory Committee, a series of reviews and studies were prepared, and are hereby appended as annexes:

Annex I: Progress Report on Actions taken by UNEP to Contribute to the Preparatory Process of UNCED in the Field of Desertification, in response to Decision 1/15, paragraphs (a) and (c);

Annex II: Review of Drought Monitoring and Research Activities Currently Being Undertaken by the Agencies of the United Nations System and Other Relevant Organizations, in response to Decision 1/15, paragraph (d);

Annex III: Expanding Reforestation Activities to Combat Land Degradation and Desertification, in response to Decision 1/15, paragraph (e); and

Annex IV: Alternative and Sustainable Systems of Production and Livelihoods in Marginal Lands, in response to Decision 2/11, paragraphs (a) and (b);

II. REVIEW OF MAIN ISSUES CONCERNING LAND DEGRADATION, DESERTIFICATION AND DROUGHT AND LINKAGES BETWEEN THEM AND OTHER TOPICS OF THE CONFERENCE

4. The Preparatory Committee, at its second Session emphasized the close links between land degradation and desertification when it concluded that "the general problem of protection and management of land resources forms the background to action on deforestation and desertification ...".

5. This is a fundamental conclusion, where desertification control is considered in the much broader context of land management in general. This concept is also indicative of the development of thinking on what desertification is. Fifteen years ago, in 1977, the Conference on Desertification (UNCOD) referred to desertification as "... the diminution or destruction of the biological potential of the land, ... and can lead ultimately to desert like conditions ...". Currently, a generally accepted definition is "... desertification is land degradation in arid, semi-arid, and dry sub-humid areas resulting from adverse human impacts ...". This definition emphasizes desertification as essentially caused by man, and as an often irreversible process with a significant negative impact on sustained productivity and on the well-being of the populations involved.

6. Three issues are important when considering the origin of desertification, these are: the direct causes of desertification, the indirect causes, and the occurrence of droughts. The degradation of soils and vegetation in dry lands is the direct result of poor management and use of these soils and vegetation. In other words it is the result of poor land use. This poor land use can take on different forms and desertification can be caused by poor dry land farming or poor irrigation practices, by poor grazing practices, or by uncontrolled deforestation.

7. The farmers and herders who use these poor land-use practices usually are aware of the degrading effect of their operations. They often operate in conditions where there is little or no alternative. The conditions which lead farmers and herders to detrimental land use practices are determined by other causes. These indirect causes of desertification are generally of a social, economic or political nature. It is critically important to take these indirect causes into consideration when designing measures for desertification control. Typical indirect causes of desertification are growth of the population occupied by and dependent on agriculture and livestock; urban development with ever increasing demands for land, food and fuel; policies that encourage production of crops on marginal lands and international economic conditions that constrain the options available for sustainable use of drylands.

8. Desertification is aggravated by drought, desertification processes are accelerated by drought, the reconstitution of a vegetative cover and the reconditioning of soils is retarded by drought, and certainly by the prolonged droughts in the Sahel of recent decennia. However, in this view drought is not considered a main cause of desertification. On the contrary, there is a suspicion that desertification may cause the prolongation of droughts.

9. On a global scale, dry lands and their vegetation are limited resources which need to be managed well to maintain their productive use, their existing biodiversity, and their importance as reservoirs of clean air and viable space to live. On a national scale, dry lands and their vegetation are the only land and vegetation resources of many countries, and thus need to be managed carefully to maintain a nation's only resource base, or even its identity or bare existence. On a local scale, proper use and management of dry lands and their vegetation is a matter of life and death for millions of people, often among the poorest in the world.

10. Desertification control therefore is of crucial importance in the management and protection of the world's dry land environments and in the development of its people. There is no doubt that this will require major investments. Each one of the three major concerns mentioned above is reason enough for major allocation of funds to desertification control. The combined global, national, and local interests that are at stake in sustained development of the world's dry land environments call for levels of investments and spending.

11. Important linkages also exist between land degradation, and particularly desertification, and other topics of the UNCED Conference. Large scale desertification problem affect atmospheric conditions and may influence climate change and cause transboundary air pollution; there are direct and causal links between desertification and drought; the availability of fresh-water resources, both in terms of supply and of quality, is directly influenced by desertification; regional seas and coastal areas experience increased siltation and sedimentation.

III. CURRENT WORK IN THE AREA

12. Below are summarized the current work in desertification control by organizations of the United Nations system, in particular by UNEP, FAO, IFAD, UNESCO, UNSO and WMO.

The United Nations Environment Programme

13. UNEP is one of the lead agencies in the United Nations system working on desertification matters, through its Desertification Control Programme Activity Centre (DC/PAC). UNEP works in close collaboration with other agencies of the United Nations system, exercising its catalytic role. As part of this work, it collaborates on a joint venture with the UNDP/UNSO in field work. The work of UNEP will not be described in detail here, as it is currently preparing a series of reports on the matter (see Annex I of the present report).

The Food and Agriculture Organization (FAO)

14. Following the recommendation of the FAO Committee on Agriculture (1987) an operational strategy is being developed for "improving productivity in dryland areas" which identifies priority areas and an action programme. The recent Inter-agency Preparatory Meeting on Water and sustainable Development included an Expert Group on Water Scarcity and Drought Management which identified priority areas for inclusion in an action programme.

15. Activities under FAO's Arid Land Forestry programme aim at: (i) better knowledge of resources, especially those having a significant bearing on food, fuel and fodder production; (ii) improvement of technologies (desertification control measures, sand dune stabilization, natural forest management); and (iii) strengthening regional and sub-regional cooperation. The FAO/IBPGR/UNEP Project on genetic resources of arid/semi-arid zone arboreal species for the improvement of rural living, has as its main purpose the collection of seed from arid and semi-arid zone woody species in the collaborating countries and its distribution of species to institution, organizations and projects in different countries. Monitoring of vegetation and precipitation in Africa is carried out using FAO's Africa Realtime Environment Monitoring System (ARTEMIS).

16. In 1986 FAO completed the study "African Agriculture: The Next 25 Years." This study highlighted the problem of land degradation and recommended that a conservation strategy be developed for the continent. FAO has now developed an International Scheme for the Conservation and Rehabilitation of African Lands. The purpose is to provide a means by which African countries can develop their own programmes to fight land degradation. FAO has substantial activities on drought preparedness. An FAO working group on desertification control addresses conceptual issues related to desertification in relation to agriculture, forestry and fisheries.

17. A recent review made for Africa indicated that about 184 projects address the problems of desertification; these projects are implemented in 32 African countries with financial support amounting to about $US 85 million. These projects relate to dryland agriculture, energy, forestry, integrated land management, planning, monitoring and coordination of policies related to desertification and drought, range management, soil protection and improvement, water resources management and development.

International Fund for Agricultural Development (IFAD)

18. The objectives of the current phase of the Special Programme for Sub-Saharan African Countries Affected by Drought and Desertification (Special Programme) are reviewed in Part I of the Report to the Fourteenth Session of the Executive Board on the Mobilizations of Additional Voluntary Contributions for the Special programme for Sub-Saharan African Countries Affected by Drought and Desertification (document EB 90/41/R.87/Rev.1).

19. By the end of 1990, a total of SDR 200 million (representing 96% of pledges made) from the special Resources for Sub-Saharan Africa had been committed and approved by the Executive Board of IFAD for 27 loans and associated grants supporting 26 projects in 20 countries. The production measures instituted under the 26 Special Programme projects will promote food self-sufficiency for the most disadvantaged groups, estimated at approximately 1.9 million farm families (about 13 million people). Women are specially targeted under a number of those projects. The major production increases are expected to result from traditional staple crops (such as cassava, cowpeas, pulses, roots and tubers, sorghum and millet) and environmental protection measures, which will increase yields.

20. Recent proposals emphasize the need to consolidate and expand the achievements of the Special Programme, First Phase, in smallholder agricultural development and environmental conservation in drought-prone areas of sub-Saharan Africa through a Second Phase. Thus, while successful initiatives introduced under the SPA-I will be strengthened, new initiatives will be promoted under the SPA-II. These initiatives would include: (i) undertaking environmental conservation on off-farm communal lands, (ii) improving rural energy through the introduction of alternative energy sources and energy-saving equipment; (iii) emphasizing integrated pest management as a means of fostering ecologically-appropriate pest control; and (iv) promoting off-farm income-generating activities to help reduce population pressure on land.

United Nations Educational, Scientific and Cultural Organization (UNESCO)

21. UNESCO's program on Man and the Biosphere (MAB) provides the scientific basis to deal with problems of the utilization and conservation of resources and resource systems, emphasizing integrated and interdisciplinary research which has a direct and pragmatic application for improved land use and resource management. The programme is organized through sub-regional, regional and international research networks, along thematic or geographical lines, or a combination of the two; it includes projects in sub-humid tropics, arid and semi-arid zones.

22. Among UNESCO's principal projects in the arid zones that deal with desertification control are: IPAL Kenya-Integrated Project for Arid Lands of Northern Kenya; IPAL Tunisia-Integrated Project for Arid Lands of Tunisia; FAPIS-Project de Formation en Aménagement Pastoral Integré au Sahel. With the support of Germany, UNESCO has also embarked on a major new project: "Strengthening of the scientific capabilities of the Sahelian countries in the agro-sylvo-pastoral field".

United Nations Sudano-Sahelian Office (UNSO)

23. UNSO's actions focus on the recovery and rehabilitation of natural productive resources and securing the promotion of sustained economic development. In recent years, UNSO has engaged in a number of activities that range from a series of country-focused assistance to planning and coordination to implement projects and programmes dealing with the management of the natural resources. New activities related to the preparations for the UNCED 1992 have also been initiated.

24. Assistance to Governments in the area of planning and coordination focus primarily on the preparation of strategic frameworks for developing activities for the protection and management of productive natural resources. UNSO's activities are directed towards improving the capacity of government focal points dealing with the management of natural resources, as well as the establishment and strengthening of national mechanisms such as advisory and coordinating units, scientific advisory councils or national committees for desertification control. These efforts are geared towards integrating environmental concerns into the main stream of country development plans.

25. UNSO supports programmes and projects addressed to medium to long-term environmental rehabilitation issues by focusing primarily on four broad categories: deforestation control; rangeland management and water resources development; soil protection and sand dune stabilization; and integrated land management. In deforestation control UNSO's strategy calls for such actions as increasing wood resources supply through afforestation, reforestation, agroforestry, community agroforestry, and restocking of gumbelts; wood resource demand reduction and management through improved wood fuel consumption technologies and wastage reduction; wood resources substitution by other biomass or non-biomass forms of fuel. Pasture and rangeland degradation affect many parts of the region as human and livestock pressures approach or exceed the carrying capacities of the rangelands. UNSO supports the development of the second phase of the project for the integrated development of the lake zone in Mali. The project has established several village-level organizations to ensure the management of rehabilitated land and has initiated family-based reforestation in selected target villages. In the coming year, the project aims to carry out water and soil conservation experiments and conduct socio-economic surveys relating to the rational management of Bourgou pasture. Preparation is under way for a third phase to help consolidate earlier successful phases. Support for projects dealing with water resources development also continues for integrated land management.

26. UNSO efforts in programmes and projects have placed more and more emphasis on holistic approaches that combine different production activities - mainly cropping, livestock development and forestry. The Sahara-Sahel observatory (OSS), a programme to strengthen the mechanisms that currently exist to fight desertification in North Africa and the Sudano-Sahelian region, was initiated by the French Government as a framework for regional and international cooperation. Activities were launched by UNSO to carry out the OSS programme an inventory of organizations, programmes, projects and experts (OPE) in the field of monitoring the dynamics of desertification and in the field of research. UNSO continues to serve as the United Nations Focal Point for the permanent Inter-State Committee on Drought Control in the sahel (CILSS) and the Inter-Governmental Authority for Drought and Development (IGADD).

27. UNSO has concentrated its efforts to create a greater degree of public awareness on the need to improve the protection and management of the productive capacity of the natural resources. Its activities focused on supporting-awareness raising events, promoting environmental education and communicating its experiences on projects and programmes to decision makers and development specialist. Overall, UNSO has made considerable progress in addressing the problems of natural resources management in the Sudano-Sahelian Region. The issues related to management of natural resources are beginning

to be treated more systematically in country development plans. There is also increasing support among donors, international development organizations and the countries themselves for practical arrangements to coordinate, monitor and share information at local level.

World Meteorological Organization (WMO)

28. WMO action proposals to combat drought and desertification include:

(i) Continued assistance to Members to establish, operate, maintain the observation network, the collection, communication, analysis and dissemination system with appropriate data management and derive benefits from an effective network for meteorological and hydrological data;

(ii) Continued support and sponsoring of suitable research and development projects in drought and desertification ranging from local micro-scale processes to the application of general circulation models. Support for the following is envisaged: (i) studies on causes of drought; (ii) development of methodology to monitor drought and assess it severity and impact; (iii) modelling of the atmosphere and ocean and drought occurrence; (iv) development and operational used of forecasting techniques; (v) development of model drought response plans; (vi) support to pilot projects to test the formulation, dissemination and use of required meteorological and hydrological information.

(iii) Continued assistance to establish and operate the Drought Monitoring Centres;

(iv) Continued support to Members on training and educational activities. These include (i) publication of practical manuals on drought and desertification; (ii) organization of workshops, seminars and training courses on operational forecasting techniques; (iii) organization of roving seminars on such topics as the long-term assessment of water resources, the efficient use of water, on bush and forest fire management, on the carrying capacity of pasture and rangeland using meteorological data, and on rainfall agressivity and erosion control measures; (iv) updating of relevant WMO publications; (v) sponsoring fellowship training in Member countries as appropriate.

IV. PROGRESS IN IMPLEMENTING MEASURES TO CONTROL DESERTIFICATION, IN PARTICULAR THROUGH THE PLAN OF ACTION TO COMBAT DESERTIFICATION

Results achieved

29. For many years now, major efforts to control desertification have been made by the inhabitants of dry land areas, by the Governments of the more than 75 countries affected, and by the international donor community. In many instances these efforts were guided by the United Nations Plan of Action to Combat Desertification. This plan was adopted at the United Nations Conference On Desertification held in Nairobi in 1977 (UNCOD, 1977).

30. The Plan of Action to Combat Desertification (PACD) is a 40-page document which sets out ways to combat desertification. The PACD is addressed to scientists and technical specialists such as natural resource management specialists and land use planners, but also to policy makers and decision makers at the national level. The following goals and objectives set for PACD clearly establish the major thrust of the plan. The immediate goal of PACD was "to prevent and to arrest the advance of desertification and, where possible, to reclaim desertified land for productive use". The ultimate objective of the PACD was "to sustain and promote, within ecological limits, the productivity of arid, semi-arid, sub-humid and other areas vulnerable to desertification in order to improve the quality of life of their inhabitants".

31. The PACD as designed in 1977 essentially consists of a series of basic, guiding principles and 28 detailed recommendations. These principles and recommendations for desertification control are generally sound and remain valid to this day. The problem is that, despite this plan, desertification remains unabated, more land is desertified now than it was in 1977 and a larger population is affected. It could of course be argued that desertification problems might have been worse without PACD. However, the general consensus is that there are major shortcomings in current desertification control, and improved control is possible and necessary.

32. UNEP has recently carried out an evaluation of the implementation of the PACD (UNEP/GC.16/16/Add.1: External Evaluation of the Plan of Action to Combat Desertification). This evaluation identified a series of shortcomings in the implementation of the PACD, and, in particular, the lack of priority given to desertification problems, and to the PACD, lack of financial resources, lack of coordination, failure to include desertification control activities in national development plans, lack of government machineries to implement the PACD, lack of community participation; incidence of drought and the complexity of the PACD design.

33. A distinction is made in implementing the PACD in industrialized countries which are able to cope with the problem by themselves and developing countries which need major external assistance of their solution. In the industrialized countries like Australia or USA, development is not dependent on drylands and the problem of desertification can be approached there from the economic and technical point of view; how to stop land degradation and to optimized the economic return from drylands. In most developing countries, and in particular in the Sudano-Sahelian Belt of Africa, the natural resource base is the main resource upon which a development process will have to rely and the social systems interacting with dryland resources make the problem much more complex requiring a holistic approach based on dryland development. Therefore, for the majority of countries affected by desertification, the PACD is in effect, a plan of action for reducing land degradation through dryland development.

34. If we take, for example, the case of Africa, we will see that of a population of about 609 million in 1988, an average of 80% are engaged in agricultural production. The United States on the other hand, with less than 30% of the African territory, has less than 4% of its population, of around 254 million, engaged in similar activities.

35. It seems evident that the difference between developed and developing countries is structural. This difference is primarily in the technological means available as well as the technological efficiency achieved in that sector of economic production. There is an interplay here between technological progress and the evolution of the productivity of labour. Hence, action to reduce land degradation must include a socio-economic dimension based on a development approach. It must be recalled that most of the countries suffering from desertification suffer from poverty, and also have the heaviest debt burden in relation with their GNP. Hence a resolution of the international economic problems confronting these countries is necessary if they are to effectively tackle the problem of desertification. Furthermore, most of them lack the basic logistical infrastructure as well as the volume of financial, human and technological resources needed for growth and employment that would improve the living standards and the habitats of the rapidly growing populations.

36. Desertification and soil degradation, because of its vital importance for hundreds of millions of people, requires more than other problems an understanding of the link between environment and development. The international community should be concerned by desertification, drought, land degradation and management, not as pure environmental issues, but because of their inhibiting impact on the eradication of poverty and the improvement of living conditions, habitat and human health as well as the sustainability of economic growth and development.

37. It is necessary to underline that what is required from countries suffering from desertification is to define realistic and operational policy options as well as strategies and programmes for the incorporation of the environmental dimension in the planning of their socio-economic management instruments. In fact, it is necessary to manage the environment as an economic asset.

38. Inability to generate new income and livelihoods from land for a growing population is often characterized as limited carrying capacity of land. This notion, however, is a physico-technical description that provides no clear policy directives. In reality and in economic management terms, since arable land resources are a fixed quantity, both the increased productivity of labour and the absolute increase in the size of the population, simply create an excess demand for arable land which has to be absorbed by the creation of alternative and new employment, as a source of new income and livelihoods.

39. A policy of fighting the rural exodus while striving to maintain each farmer's income level, is thus a direct inducement to land degradation, to the exploitation of marginal lands and the forcible decrease in the productivity of labour. Concerned countries should be vigorously pursuing employment creation policies and alternative livelihood systems outside farming and cattle raising. Those policies should concern the most sensitive socio-professional categories such as landless farmers, women and youth and could be essentially articulated around the promotion of incentive for alternative activities and building up related capacities and expertise.

Control measures applied

40. It is recognized that while combatting desertification is vital throughout the drylands, there is no suggestion that a dramatic intensification of carrying capacities in rangelands can be achieved. Further there is an urgent need to stop soil degradation and loss in areas of rainfed cropland, to reclaim them and to sustain their productivity.

41. The above considerations determine the main priorities in the implementation of the Plan of Action to combat Desertification (PACD), although the actual priorities must be country-specific and may not be the same throughout the world. Furthermore, the dynamic overlap between the major land-use systems must not be overlooked and to counteract this, an integrated systems approach is emphasized in combating desertification and dryland development taking into account the interdependence of rural and urban societies and policies as well.

42. In order to achieve the goal of reducing land degradation through dryland development, the strategy is based on identifying and implementing actions leading to sustainable development, including environmental control with special emphasis on protection against soil loss, and soil, water and air pollution as well as deforestation; and social, economic, cultural and political development with emphasis on satisfying human needs. It is recognized that broad based public participation including all sections, both rural and urban, of the affected community including women, indigenous groups and representative NGOs, is most essential for implementing the PACD.

43. Indeed, the physical dimension of analysis in the exploitation of natural resources would alone not be sufficient for an effective solution. The management of the physical environment depends on a society's cultural and aesthetic values and consequent social, economic and political thought and organization. This socio-cultural ecology in turn determines the development of technology and other means needed to implement that society's fulfilment and development goals, taking into account the current stock of economic means, the prevailing world context and rules of operation.

44. Below are brief reports presented as background information on control measures in three different parts of the world - the Sahel and North Africa, India, and Chile. Specific suggestions for desertification control are also presented.

(i) Desertification Control in the Sahel and North Africa

45. For more then ten years now drought has become a persistent phenomenon to the extent that the northern limit of rain fed agriculture in the Sahel has moved to the South. A comparison of present rainfall averages with averages of the period 1930-1961 leads to the conclusion that there is a climatic regression. This is even more worrisome as many development projects were designed on the basis of rainfall conditions which these days would be considered very favourable. Equally significant is the situation with surface water and ground water levels which have also been subject to an important decrease, thus limiting the possibilities for irrigation. For example the important fluctuations in stream flow of the Niger and Senegal rivers, which

are characterized by lower maximum flows and longer minimum flows. The discharge of the Komadougou river is reduced to half; Lake Chad no longer exists in Niger.

46. Under the influence of climate and man the productive potential of North Africa and the Sahel region is declining. The loss of productive capacity caused by desertification manifests itself in the degradation of soils and range-lands: The progressive destruction of the vegetation cover, the reduction of water infiltration, the development of erosion, and the wood supply crisis. The productive potential is increasingly burdened by growing demand which exceeds its recuperative capacity. The relatively high level of population growth and its consequences does not make it easy to reverse the current trends.

47. The persistence of drought in these last years has given the population of the Sahel the idea that a new, permanent situation has developed. This is how village communities perceive the degradation of their production potential when considering the scarcity of wood, which needs to be gathered further and further away, the loss and degradation of crop lands and range lands, the threat to their own village sites by erosion and sand dune development. This is a positive attitude on which one should capitalise in the design of measures for controlling desertification.

48. The Sahelian countries are characterized by a high growth of their population. This influences the productive potential. There is an increasing demand for farmland, competition between herders and farmers, between farming and forestry. The resurgence of land tenure problems is indicative of a rural crisis as well as of the gap left by the traditional systems in regulating the use of natural resources. This constitutes a major factor in the degradation of the environment. Land pressure remains a major element in degradation and is exacerbated by the population explosion of the last years. This results in: An increase in cultivated land, the over exploitation of land and the disappearance of fallow, and excessive deforestation due to increasing wood consumption. Seasonal migrations towards urban centres is an ancient practice. They have intensified in the last years. This exodus is an indication of social crisis situations, but it indicates more then anything the limitation of the environment to absorb all labour because of the lack of competitiveness of traditional production systems, the land tenure crisis, and the weakening of the customary social systems.

49. The Sahelian countries are characterized by unfavourable development of their economies which makes them continuously dependent on foreign aid. All countries are confronted by a disequilibrium in their balance of payments (decrease in exports of agricultural products and increase in imports), a heavy national debt, a substantial public sector which consumes important financial resources and is often inefficient. There is also a tendency of insufficient food production. In fact cereal production depends on climate and with the growth of population it becomes more and more difficult to ensure sufficient production to cover their needs. However the resources of land and water would allow a substantial increase in production. The problem is to improve production systems. Project policies and strategies should focus on reducing food dependence and on allocating funds for productive investment.

50. Desertification is the major physical constraint with which the Sahelian countries have to cope. This results in regression of the vegetation; decrease in animal and vegetative production; land degradation; lowering of ground water levels; encroachment of sand dunes; decrease in surface water resources; migration of people to more favourable areas.

51. Efforts to control desertification are hampered by numerous constraints such as climate (low and erratic rainfall, strong winds, frequent lowering of ground water levels); traditional farming and grazing systems; high rate of growth of population and livestock; weakness of national economies; inadequate legislation and government structures; passive attitude of the population.

52. Since desertification is a complex phenomenon with consequences in many sectors of the economy it is necessary to take a global approach in finding solutions. Solutions should take into account the two critical elements in the desertification process: climate and human activity. In an integrated development approach efforts should aim at the fight against desertification and at alleviating poverty. Solutions should also be based on an in-depth diagnosis of the extent of desertification, and other limitations should be taken into account to develop policies and strategies for the fight against desertification. This approach did not exist: current actions are not integrated and are carried out on a sector basis and in most cases at levels far below the needs.

(ii) Desertification Control in India

53. In view of the severity and magnitude of desertification in India, many efforts, both Governmental and voluntary, have been made to combat it. A review of the scenario after UNCOD, 1977 is presented below.

54. Since UNCOD 1977, research carried out on combating desertification at various research institutions in India has yielded rich dividends. Technologies have been developed at the Central Arid Zone Research Institute (CAZRI) for sand dune stabilization, shelter belts and wind breaks plantation, grazing land development, management and utilization, their economic viability has also been established, and in addition to besides ecologically ameliorative impacts. Success has been achieved with desert jujube which has become popular in India. Strategies have been defined for optimising limited water for irrigation through drip and sprinklers for fruits and grain crops as well as forage crops; besides using mulches and saline water for cropping. Proven technology exists for controlling rodents, white grubs, termites, grass hoppers and Katra (Amsacta). Emphasis is now being given to silvipastoral and agroforestry research. To encourage the use of alternate sources of energy, solar water heaters, solar dryers and solar cookers have been prepared and are becoming popular.

55. Information on availability and location of wastelands is the first information required for afforestation and other anti-desertification measures. The Government of India initiated a nationwide survey and mapping of wastelands in 1985. In the first phase, 182 critically affected districts

(including all 12 districts of western Rajasthan deserts) covering an area of 15 million square km (46% of the country) were selected for mapping at 1/50,000 scale through remote sensing. Thus, wasteland type, location, and extent were available in each village in each district. Simultaneous efforts on afforestation have also been made in Rajasthan. Till 1987, 33,093 ha has been put under strip plantation along roads and canals, 358,578 ha of barren and degraded forest have been afforested. Community land plantation has been done on 46,911 ha, sand dune stabilization and pasture development on 262,040 ha, aerial seeding on 19,200 ha.

56. Currently continuous attention of scientists and technocrats is on standardization of monitoring of desertification, understanding the nature of ecological degradation of soil, water and vegetation, standardization of biotechnological means of multiplication of elite woody perennial, evolving high yielding grasses, legumes and fruit crops, and on the management of salinized and mine spoilt soils. Also, the use of industrial affluent water for raising trees and grasses, integrated development of water sheds, standardization of specifications for water bodies such as village tanks and village ponds, standardization of water requirements for woody perennial, use of VAM in forestry and allied species, and finally modelling efforts for predicting yield of grain, straw, forage and wood in respect of various species, are becoming increasingly important. These activities are being carried out at a large number of research institutions located in the Indian desert.

57. The above review reveals that given the environmental limitations, control of degradation in arid situations is especially difficult, in the socioeconomic set up of the Indian desert. Although a multifaceted and multipronged approach is being followed in combating desertification, a few aspects have yet remained unattended or have to be given fresh thought. There is no system to rationalize ground water utilization. Since it is a limited resource, with poor recharge typical for the arid areas, over exploitation will deplete it fast. Formulating a ground water policy is urgently desirable for its optimum and rational exploitation. Likewise, with canal water becoming available for irrigation, farmers tend to use it, rather overuse it, to get higher yields. But in this process, land is permanently damaged. Therefore, attention must be focused on evolving a suitable irrigation policy for desert areas in view of harmful effects of indiscriminate irrigation. The other important issue that requires social acceptance, political will and scientific skill is a suitable grazing policy. A draft National grazing policy has been prepared in India and it is being debated before it is finalized. An important issue is the establishment of livestock ceilings, through political will and/or social education. These are some of the issues that deserve attention at the international level, too.

58. In terms of areal strategy, the emphasis has to be on stopping the spread of degradation beyond the desert per se. Thus, wetter margins of the desert need immediate attention. Within the desert, much of the socioeconomic fabric revolves around water points /bodies, which already exist. These sustain human populations and also the livestock who graze in its catchment area. Society also has its places of worship around these village water tanks.

Efforts have to be made to improve the ecological conditions of these water bodies through proper drainage, storage, and lessening siltation by planting grass and shrub, which would also provide additional fodder.

59. Since water, not land is a limitation in the Indian desert, the storage and use of water should be such as to ensure human and livestock survival. If additional water is available for irrigation, a larger area could be irrigated through drip or sprinkler systems. Since perennial vegetation provides stability to arid ecosystems, its plantation should be encouraged in the crop fields (agroforestry) and grazing lands (silvipasture). Then moving sands deserve utmost attention. Sand dune stabilization is, therefore, an important activity besides providing shelter belts and wind breaks. Pest management, using alternate sources of energy, range improvement and utilization, mine spoils reclamation are other areas for anti-desertification research.

(iii) Desertification Control in Chile

60. The desertification process in the Americas has been established over several centuries. Desertification was present before the coming of European colonizers. The introduction of new plants and animal species, new exploitation techniques, and the overall incorporation of the productive system in regional and world-wide commerce provoked important changes in the type and degree of pressure on the soils. However, not all changes resulted in soil degradation. For example, there was significant land abandonment and concomitant soil recovery in sub-humid areas due to the introduction of more productive species and cultivation techniques, and to the decrease of the indigenous population caused by disease, wars, and migrations. In more arid areas, the decrease in population was not accompanied by soil recovery. Here the collapse of indigenous social systems led to the abandonment of complex resource management systems such as irrigation and terracing, and was accompanied by the introduction of Eurasian domestic animals (bovines, sheep, goats and horses) which had not co-evolved with native vegetation. The resultant interaction was usually destructive for native vegetation.

61. Desertification is not an inexorable progression from "desert centres", but it worsens or reverts through the centuries depending on the interaction of political and economic external factors acting in combination with ecological parameters such as climate, soil and vegetation. This gives rise to a complex mosaic of situations and not a specific lineal tendency. Advancing and retreating zones can be present within short distance of each other, although logical cycles and general tendencies do exist.

62. The identification of a certain number of technical solutions to combat desertification that have succeeded under certain circumstances is no guarantee that they are universal solutions nor that they would succeed under different circumstances. It is particularly important to remember that the success or failure of any given technical solution depends on proper diagnosis of the situation where the solution is applied. There always exists the temptation to put off such an uncomfortable, unattractive and generally difficult, diagnostic phase. For a national or international agency it is also a problem to have a diagnosis which indicates that a technical solution does not exist. This is because it is generally believed that such agencies have plenty of solutions, experts and money, to make "the desert flourish."

What is forgotten is that any proposed action (besides being technically viable) must be better than many other proposed actions that compete for the same scarce financial resources available.

63. Furthermore, the same technique can have completely opposite effects when applied in a different place or in a different period of time. The introduction of a new cultivation practice might generate greater incomes and at the same time require larger investment in soil and water conservation. In another case, using the same new cultivation practice could trigger erosion processes or expose the farmers to the fluctuations of distant markets, over which they have no control.

64. Lack of information about the condition and tendencies of desertification makes mechanical transference of techniques from one place to another uncertain. Moreover, dealing with peasant populations who trust neither people nor ideas coming from outside their own environment, requires long periods of personal contact and preparation. This does not fit with the time frames of lending agencies with planning and action horizons barely exceeding two or three years. These agencies need to show quick results in order to keep the support of developed country governments. The tendency to undertake new projects frequently affects the continuity of ongoing projects.

65. Because of the heterogeneous nature of the complex mosaic composed of ecological and socioeconomic conditions, every case requires the application of a set of distinct techniques. These techniques must be framed inside a developmental strategy or set of strategies. The problem called desertification has not been solved. There still exist forms of use that lead to degradation of marginal lands. However, there do exist some strategies and courses of action that seem to be successful, though it must be recognized that a great part of these solutions is a consequence of the development of other activities aimed at providing jobs or income alternatives to rural populations.

66. Among successful strategies are:

(i) Subsidizing the planting of selected species of trees in order to provide fodder for domestic animals and firewood for household or commercial use. Subsidies are used only to generate a stable source of income and are not intended in themselves to be ongoing contributions.

(ii) Vertical integration of commercial circuits to increase participation of the population in generating incomes through productive activities.

(iii) Increasing the quality of basic rural education in order to give youth who will remain in the countryside better tools to incorporate technological innovations and adapt to changes of the socioeconomic environment.

(iv) Establishment of Protected Area Systems (national parks, national reserves, natural monuments) in order to assure the subsistence of key elements of arid zone biodiversity, to provide sites where it would be possible to develop experiments in the rational utilization of renewable semi- arid zones resources, and to provide a nucleus from which it would be possible to develop rural development programs.

(v) Expansion of some traditional income generating activities which, although initially secondary to the rural household economy, have good market expectations. This strategy tends to provide multiple financial incomes and is linked to the integration of commercialization circuits.

(vi) Assignment of rights and responsibilities to the community and the generation of organizational forms that induce rural population cooperation in order to counteract habitual tendencies toward extreme individualism. This policy is most difficult to apply, and sometimes there are unexpected results. For instance: Where property titles are granted to squatters, a percentage of these new landowners sell their rights and then migrate or else remain in the same area in worse economic condition than when they were squatters, without property titles.

67. Successful technical solutions generally put into practice the policies stated above. They help maintain renewable natural resources in areas which are marginal or susceptible to degradation. Among these are the following:

(i) The planting of forage shrub species, especially the genus Atriplex. Through joint efforts among universities, public institutions, and private entrepreneurs (small and medium sized businesses), a technology for the propagation and plantation of forage species has been developed. This technology shows coherent and predictable results when it is applied within a geographic range where previous tests have indicated the ecological tolerance rank of each species (mainly defined by soil salinity and by competition with other species). This technique has ample applicability at world level but requires a trial period of about ten years to determine suitable species and their potential plantation range. In turn, a requirement for extended field work implies the need for solid national support or a substantial long-term involvement from a funding institution. These plantations have demonstrated a very positive collateral effect in that they provide a stimulus for the rural population to modernize their pasture systems.

(ii) Mist captation to produce potable water and water for industrial use or irrigation. This technique depends on very particular climatological and topographical conditions. Therefore, it is not possible to recommend a generalized application. However, in some sectors with tendencies toward extreme aridity, this technique can provide an integral solution to the problem of providing water for small or medium-sized human settlements; this opens possibilities for complementary work that could revert soil degradation processes in given areas.

(iii) Promotion of arts and crafts. At the world level, an important percentage of non-agrarian populations in developing countries obtains its total or partial subsistence from activities linked to the production of utilitarian or decorative objects utilizing non-industrial techniques. In these cases, labour costs represent a high proportion of the final product price. Industrialized countries have an increasing demand for hand-crafted products. This makes possible a financially viable activity built on local tradition and techniques. Also, this can be an easy way to promote employment for women since many towns have

some form of handicrafts traditionally made by the female population (even though their products remained in the home and generated neither income nor recognition for those who worked in this activity.

(iv) Wildlife management. This is a very old technique, but the results are valuable enough to rescue and adapt it to contemporary conditions. In general, wildlife populations have severely diminished due to hunting or human interference with habitat. Wildlife has the ability to utilize environments and food sources that are not suitable for domestic livestock, or wildlife can complement domestic livestock in less harsh environments. Protection and population increase constitute the beginning phase of this technique, more complex is progressing to the utilization phase. This is because utilization requires integrating mechanisms for distributing benefits among local human populations (ethnic minorities or peasant groups). If a project achieves success at the utilization phase, fauna management allows non-destructive use of natural resources in fragile zones (the generating of meat, leather, furs, fibers, eggs, feathers and other goods for self-consumption or marketing). At the same time, recreation and tourism opportunities are provided. The mechanisms for increasing wildlife populations or extracting and transforming products are better known than equitable distribution of benefits systems, but there also exists experience in that field.

(v) Management of reserves and other protected areas. Although the establishment of reserves and parks was traditionally considered a preservation action with no connection to development, in the last two decades it has been very evident that there is a connection between these two concepts. During this time, protected areas have seen revalued their role in the preservation of biological diversity, a valuation that proponents of development had never previously considered as worthy of taking into account. Additionally, it has been seen that reserves provide an especially practical framework for scientific research on field techniques, where experiments with forms of non-destructive use of renewable natural resources can be performed.

(vi) Control of vegetation fires. The uncontrolled use of fire in sub-humid zones has been an important factor of desertification in Mediterranean ecosystems of South America. A forest fire prevention and fighting system was implemented about twenty years ago. This was accompanied by an education campaign and some flexible but practical regulations with respect to using fire as a tool to habilitate land for cultivation and with respect to eliminating forest exploitation residues. The application of such norms and regulations has resulted in increased ground cover and biomass per hectare as well as increased woody vegetation (both trees and shrubs).

(viii) Planting woody species. Tree planting to produce firewood, construction materials (fence rails, poles, etc.), or other products (fruits, barks, etc.) are recommended. One of the most typical symptoms of desertification is that vegetation susceptible for use as combustible material disappears. There are experiments with the planting of fast-growing species in zones where there exist supplies of

water such as river courses, proximity to irrigation channels, or high water tables. It is possible to establish slower-growing species in zones where the only source of humidity is precipitation and the occasional contribution of fog. Plantations can be made with industrial objectives in sub-humid areas where the wood supply situation is not so critical and annual volume growth is better.

Financial and technical support given

68. At this stage, the information received on the exact financial resources allocated specifically to addressing the problem of desertification, still remain fragmentary. The issue of financial requirements for desertification control is being examined by UNEP.

69. Data on the issue are available in the report "The Drought and Desertification in the Context of the UNPAAERD". This report was prepared by UNSO with the active collaboration of several international organizations (UNDP, FAO, UNIDO, WMO, WFP, IFAD, and IBRD) and NGO's and it is essentially based on a data analyses resulting from: statistics (World Bank, UN, IUCN, etc.), answers to two questionnaires (UNSO) and annual reports.

70. The report gives some indications of relative amounts of assistance offered to countries and of the portion of assistance related to the problems of drought and desertification. However, the available evidence from the responses received by UNSO indicates that many multisectoral and bilateral agencies may have included large amounts of allocations to projects which only have a small proportion of anti-desertification aspects.

71. An UNSO study, based on informal discussions with agencies and the comparative averaging of data obtained from the questionnaires, it is estimated about 3.5% of total international assistance for the period can be considered as specifically related to drought and desertification efforts in Africa. It is estimated that, in 1986, $US 490 millions in assistance provided to Africa in relation to the problems of desertification and drought. This constitutes 3.5% of total assistance of the $US 14 billion extended during that year. The level of total ODA in 1987 increased to $US 16 billion, of which an estimated $US 550 millions were devoted to drought and desertification.

72. For a comprehensive analysis of the funding of anti-desertification programmes we refer to the forthcoming study entitled "Expert Study of Financing Anti-Desertification Programmes".

Evaluation of current programmes

73. As mentioned earlier an independent evaluation of PACD was carried out in 1990 by a team of desertification experts on behalf of UNEP (see paragraph 32 above). The evaluation assessed four issues: (i) the validity of PACD premises, (ii) the validity of PACD recommendations, (iii) the appropriateness of the mechanism for implementing PADC, and (iv) the appropriateness of the mechanism for financing PACD.

74. In doing so, the evaluation clearly went further than a strict evaluation of the PACD, the plan in itself. The evaluation also assessed why the recommendations of the plan were not followed through and were not implemented. These, of course, are two different things: the soundness of a plan, and the effectiveness of a plan's implementation. The evaluation does not explicitly list the shortcomings or weaknesses of PACD, nor does it explicitly list the shortcomings in its implementation. The evaluation continues its report with an identification of the causes for shortcomings in the implementation of PACD.

75. Eight kinds of causes for shortcomings were identified, and are summarized below again, for ease of reference. It appears that seven of the causes for weaknesses in the implementation of desertification control are unrelated to PACD as a plan. In other words, the current scarcity of desertification control measures seems, for the large part, not the direct result of an inadequate master plan. Only one of the causes for shortcomings in the implementation of PACD, the last one listed, directly concerns weaknesses in the PACD itself.

76. All the eight causes for shortcomings in the implementation of PACD identified by the evaluation team are as follows: lack of priority given to PACD by affected countries, lack of financial resources to implement PACD, lack of coordination, failure to include desertification control activities in national development plans, lack of government machinery to implement the PACD, lack of community participation, incidence of drought, complexity of the PACD's design.

77. It is conceivable that the last cause listed, the complexity of the PACD design, was and still is in fact the prevailing cause for the lack of desertification control measures. The evaluation decided that "it is difficult to say whether the PACD would have been implemented more effectively, had it been designed differently".

78. In its conclusions and recommendations the evaluation team addresses these concerns. It reconfirms the validity of the PACD as a tool for experts and technicians, and reconfirms the validity of the Plan's principles. It, however, criticizes the PACD for its lack of focus and for omitting socio-economic factors associated with desertification. These are assessed by the team as limited shortcomings.

79. As its major recommendation, the evaluation team further advocates that guidelines be developed for implementation of PACD. The team has suggested a number of issues which should be addressed in these guidelines:

(i) include desertification control activities into national development plans;

(ii) focus national and regional level implementation on the problem addressed;

(iii) emphasize socio-economic issues involving land use systems;

(iv) develop guidelines by land use system (range lands, rain fed agriculture,irrigation, other land uses);

(v) categorize PACD recommendations;

(vi) institute a central planning mechanism in affected countries;

(vii) emphasize training of personnel;

(viii) encourage NGO's;
present anti-desertification programmes as part of national plans for sustainable development.

80. It appears from the above that shortcomings in desertification control currently exist at the conceptual, planning level and at the implementation level. The conclusion is that planning needs to be better focused and implementation needs to be better articulated and prioritized and the shortcomings addressed fully. In addressing current inefficiencies in desertification control it is also important to take into consideration the recommendation formulated by UNSO (Nov. 1990), bearing in mind that this office is, since 1978, assisting in the implementation of the UNPACD in the Sudano Sahelian region, on behalf of UNEP and under a UNDP/UNEP joint venture. In reviewing the progress in the implementation of the PACD and its impact, UNSO believes that there should be more emphasis than has been given in the past in the following five areas:

(i) Incentives. While the technology for combating desertification is known, much more could be accomplished if land users and villagers had better incentives not to degrade the land and to utilize it in an environmentally sound manner. Governments, therefore, should improve incentives, including measure in such areas as physical infrastructure (marketing and pricing, land tenure and property rights).

(ii) Consciousness raising. Much has been accomplished in raising consciousness and public awareness of desertification, among both the people, the governments of recipient countries and, to a lesser extent, the international donor community. The consciousness raising among the land users should be increased, bearing in mind, however, that no amount of sensibilization will work unless the land users also see clear incentives to carry out the environmentally sound activities required.

(iii) Education. Along with consciousness raising, the curricula of the school system of the Sudano-Sahelian region - elementary and secondary - should be organized so as to include courses on the environment, sound agricultural practices, tree planting and maintenance, and the like.

(iv) Alternative and/or supplementary livelihood/production systems (See Annex IV). The whole problem of desertification should be seen in terms of the entire global production possibility frontier. This includes measures for income diversification through the promotion of non-traditional production and livelihood systems that are environmentally friendly and have higher levels of sustainability. These could address the problem of poverty and its interaction with environmental degradation. These alternative/supplementary livelihood systems could include cash crops with low extractive stress on the land (e.g. Acacia senegal, A. seyal, fruit trees, field crops, ed.g.

Simmondsia chinensis, Pathenium orgontatum, Vernonia, medicinal plants). They could also include production systems not directly land extractive, such as apiculture, cottage industries, and tourism among others.

(v) Agricultural intensification. There is evidence that much land degradation in due to extensification of agriculture into marginal lands, for which they are not suited. There should be further research on improving varieties that are drought-resistant and on agricultural intensification techniques for subsistence farmers. Such techniques should involved mixed farming, and techniques such as soil and water conservation, agro-forestry, water harvesting, small earthen dams and the like.

V. OPTIONS FOR AGENDA 21

Basis for Action

81. As explained in the previous section, efforts to control desertification have been going on for many years, but they need to be improved and made more effective. At this stage it was felt that a system was needed to better focus the control efforts. For this reason this report presents a broad programmatic framework. This programmatic framework, and the options for action proposed could later be developed as part of Agenda 21, possibly within the framework for action in fragile ecosystems.

82. The programmatic framework is intended to provide a simple, logical structure and an immediate focus for desertification control. The framework also serves as a basis for preparing desertification control action recommendations and should facilitate the selection and design of effective control interventions. At the same time, it can be used for testing the validity of ongoing projects or for evaluating new proposals suggested by others. The framework also offers a systematic way to decide on the priority of specific control efforts. Such priorities will have to be set among the many possibilities for controlling desertification in light of financial and physical constraints. In general, the framework should help to focus the discussions on desertification on the proper control efforts. It is hoped that it may be developed into a veritable blueprint, a detailed plan of operations for the control of desertification.

83. It is pointed out here that a major, new instrument for improved desertification control is currently being developed by UNEP/GRID in the form of a world Atlas of Desertification. This work, which is expected to be available in 1992, will provide world maps of soil degradation at scale 1:10 million and provide separate, supporting cartographic documents of case studies in selected countries.

Main Objective of Desertification Control

84. The overall objective of desertification control is to promote use of drylands in such a manner that it ensures a sustainable livelihood for those who depend on these resources. Sustainable use of the dry lands means that

these lands are not used beyond their capabilities for agriculture and livestock production, or non-productive uses such as recreation and military operations. The impact of desertification is felt beyond the dry regions, for example, in terms of erosion materials that are deposited by air and water in neighbouring countries, or even much farther from their origins in the dry lands. The importance of desertification control, therefore, exceeds the strictly regional concerns and interests of the drylands populations.

85. The immediate purpose of desertification control, as indicated by the term itself, is to control ongoing desertification by curtailing the further degradation of the soil and vegetation resources of the dry lands. UNCOD (1977) defined the immediate purpose along the same lines i.e."to prevent and to arrest the advance of desertification and, where possible, to reclaim desertified land for productive use." In short, desertification control aims to improve the existing land conditions in some dry areas and to keep the soil and vegetation resources in as good a state as possible in other dry land areas.

86. The existence of control operations themselves does not however guarantee that the purpose of desertification control will be achieved. Factors outside the immediate technical control operations, such as socio- economic conditions and political or religious considerations, may prevent achievement of comprehensive desertification control. Such non-technical issues must be identified as conditions that must be resolved if the control operations are to succeed.

87. The suggestions offered here have one thing in common - they are all designed to offer pragmatic approaches to desertification control. They are also designed to fit into the proposals for Agenda 21 for Land Resources (A/CONF 151/PC/42/Add.2) They must also address head on the various deficiencies identified in relation to action to combat desertification to date, and, in particular, in the implementation of the PACD, such as the lack of political will or the institutional questions. Some of these issues are already being addressed in a general manner in other papers before the Preparatory Committee, for example on institutions.

Specific Objectives

88. The management objectives of desertification control are best defined separately for the three categories of operations that are necessary to achieve comprehensive control:

(i) Prevention of the spread of desertification

89. This is more relevant for slightly desertified or non-desertified areas and the objective could be to maintain and continue proper land use. Proper land use in the peripheral non-desertified areas that are prone to desertification should be maintained through a combination of three actions: strengthening the control by village associations or nomad groups over their land resources; improving the land management techniques of local populations by modernizing and reinforcing the agricultural extension services; developing physical land use plans or master plans to guide the actions above.

(ii) Curtailment of ongoing desertification

90. This is relevant in moderately and severely desertified areas and the specific objective could be to contain and end the misuse or overuse of land resources. Two distinctly separate efforts could be undertaken to control ongoing desertification, one which focuses on misuse, and the other concentrated on overuse of the land resources.

(iii) Rehabilitation of severely desertified areas

91. This is relevant in selected, very severely desertified areas and the objective could be revegetation and rejuvenation of the area. In recognition of the fact that rehabilitation of degraded areas is a costly undertaking and will provide mostly long-term benefits, and in view of the fact that already degraded areas in many cases no longer pose immediate threats requiring immediate action, the resource recovery would be limited to selected areas.

Programme Activities

92. The priority for desertification control efforts will undoubtedly be set, at least in part, by the availability of funds. Also, desertification control is one of several environmental initiatives that will be considered by UNCED. The global priorities for control will therefore be evaluated in the context of other financial and environmental concerns. Considering this overall constraint, it seems prudent to give high priority to the prevention of desertification (category (i)) in large non-desertified areas and to the rehabilitation of certain specific severely desertified areas (control category (iii)), and then to embark on a full scale attack on ongoing desertification in moderately degraded areas (category (ii)). The prevention program could be designed to contain the spread of desertification and avoid further damage. The focus of the rehabilitation program could be on certain severely desertified areas. The program will only rehabilitate those degraded areas, such as certain watersheds, deflation areas, etcetera, that, if left untreated, continue to have a negative impact on a much wider region. Secondly, the program will rehabilitate environmentally sensitive areas, certain wetlands, wildlands, or other areas that have particularly vital ecological functions in the world's dry lands. Broad efforts to curtail ongoing desertification in other desertified areas could subsequently be undertaken in line with priorities set by each country concerned. Countries should set their priorities in deciding between measures designed to curtail degradation on over-used and on mis-used lands.

93. Over-utilization of land is often detected at a later stage, almost after the fact, i.e. after the damage is obvious. Misuse or inappropriate use of land is easier to detect and therefore easier to control than overuse. The wrong use of land resources can be recognized and terminated at an early stage. Wrong land use includes the use of sloping, unprotected lands for farming, or the use of lands unsuitable for crop production because of inherent low soil moisture. More generally, desertification control has become an integral part of development planning, particularly for the rural sector, in the relevant countries and sub-regions. It has to be integrated into programmes and policies for poverty alleviation, employment generation,

agricultural production (including in particular animal husbandry), village forestry and small industry development and settlement planning. Control programmes that operate as "add-on" measures independently of other development programmes may well fail to meet those objectives.

94. The specific programme activities (underlying policy guidelines) that need to be developed could be the following:

(i) It is important to develop non-agricultural activities in desertified areas to release the pressure on the ecosystem and thus allow for recuperation of vegetation and soils, as long as such activities are environmentally sound. It is suggested that the population concerned be supported in developing such alternative ways of livelihood, preferably in the desertified areas themselves, and, if that is not feasible, to facilitate migration and orderly settlement of the population elsewhere.

(ii) Many non-agricultural economic activities, in particular mining, take off the pressure on agricultural use of desertified lands. They thus provide environmental benefits. In dry land regions many non-agricultural projects have been proposed in the past that were considered not feasible by conventional economic standards. Such projects could now be re-evaluated, taking into account the environmental benefits of these projects gained from decreasing pressure on the land and avoiding costly desertification control programs.

(iii) Many non-agricultural economic activities, such as mining, industrial activities, road construction, and urban development may lead to some form of land degradation. The desertified regions are particularly vulnerable as degradation quickly takes on irreversible proportions and impacts the lives of a mostly poor population. It is therefore suggested that no new economic development in the dry regions be initiated without adequate environmental assessments.

(iv) Some countries have problems with desertification, but these problems only exist in certain parts of their territory. In extreme situations of land degradation their citizens can move elsewhere in the country. Desertification control, including the development of alternative means of existence, takes on a totally different dimension in smaller countries that are in their entirety subject to desertification or prone to desertification. In numerous African nations of the Sudano- Sahelian region, and of Northern and Southern Africa, and in the smaller nations of Latin America and Central Asia citizens have often nowhere else to go. Priority in desertification control could be given to countries where not only the lands are degrading, but where people do not have the option to migrate elsewhere in their country.

(v) Countries with desertification problems that are adjacent to each other could develop and agree on common strategies, policies, and regulations for land management, in particular as it relates to desertification control.

(vi) The success rate of desertification control projects needs to be improved. A strictly sectoral, technical approach has not lead to much success in the past. It is therefore suggested that desertification control be implemented in the context of integrated rural development projects whenever this is feasible. Integrated rural development should take fully into account the underlying causes - sociological, demographic, or economic - of desertification. The approach can be applied on a regional level as well as to a village level interventions.

(vii) Wherever possible, the non-profit NGO sector and the private sector should be involved in developing locally acceptable solutions and in implementing projects (see also Annex II).

(viii) All desertification control projects be undertaken after full consultation with the population concerned, in full collaboration with this population, and be combined with a program for continuing education of the population in land use and land management.

(ix) It is suggested to include a training component in major desertification control projects to improve the technical and managerial capabilities of key Government officials involved in project guidance and management.

(x) To prevent land degradation dryland farming could be prohibited in areas unsuitable for farming such as areas which are too dry, with less than 200 to 250 mm of average annual rainfall. All appropriate policy and enforcement measures could be taken to attain this, including cancellation of subsidies that stimulate crop production on marginal lands and regular surveys and inspection of land use practices.

(xi) The maintenance of forest cover in specifically targeted areas in the non-desertified zones and the reforestation of certain deforested and desertified areas is necessary to maintain a balance between fuel wood supply and demand. The role of the non-profit NGOs and the private sector in forest management, in reforestation, and in the provision of alternative sources of energy could be strengthened. In the arid region of India many companies have demonstrated interest in the development of degraded lands, and lands have been allotted to them for afforestation.

(xii) The management of irrigation systems, in desertified areas as well as in non-desertified areas, could be focused not only on crop production but also on careful water management practices to prevent land degradation due to waterlogging and/or salinity or sodicity problems.

(xiii) Degraded dune areas could be rehabilitated through dune stabilization programs, and this preferably by converting their use to forest land.

(xiv) The management of over-utilized rangelands could be improved by increasing range productivity and/or by decreasing livestock numbers, and in particular by releasing pressure on the land through the provision of fodder and browse during the most critical periods - the end of the dry season and during droughts.

(xv) In the management of severely degraded areas, and in particular their rehabilitation, which will require at least temporary prohibition of intensive use, the introduction of wildlife as a management option could be considered.

95. The implementation of the activities outlined above will involve the following:

(i) The individual citizen, or group of citizens (farmers, herdsman, urban dwellers, etc.) has responsibility for directly managing resources at the village or neighbourhood level. In many cases these citizens need a helping hand to cope with degradation problems. Such support might be provided by NGO's and by the agro-industrial sector.

(ii) National governments have responsibility for policies and plans that influence, encourage or even prescribe sustained use of the nation's natural resources. Governments have specific direct responsibilities for the management of specific areas of public land (national forests, parks, wildlife reserves, military areas) and for the definition of a realistic and operational policy options as well as strategies and programmes for the incorporation of the environmental dimension in the planning of their socio-economic management instruments.

(iii) The international community of regional organizations, international organizations, and of bilateral and multilateral donor organizations, has a critical interest in desertification control. It has to take responsibility for exchange of data among countries, arrange for input of adaptive technology, and provide the bulk of the financing for control operations.

96. For obvious reasons the three responsible groups have to work on the basis of the same control objectives and along the same lines. In effect, concerted action will be essential at both the macro-level and the micro-level. The macro-management of the nation's resources provides the technical and policy framework within which micro-management of resources at the village or neighbourhood level can be carried out effectively.

ANNEX I

PROGRESS REPORT ON THE ACTIONS TAKEN BY UNEP TO CONTRIBUTE TO THE PREPARATORY PROCESS OF UNCED IN THE FIELD OF DESERTIFICATION

A Report by the United Nations Environment Programme

I. INTRODUCTION

1. In its decision 1/15 on Soil Loss and Desertification and Drought, section II - Desertification and Drought, the Preparatory Committee:

(a) Invited the United Nations Environment Programme to implement urgently the provisions of paragraphs 6 and 7 of General Assembly resolution 44/172 A of 19 December 1989, and 44/172 B related to the progress achieved in the implementation of the Plan of Action to Combat Desertification;

(b) Invited the United Nations Environment Programme, in collaboration with relevant organizations of the United Nations system, to initiate work on the monitoring, assessment and implementation of the control measures in the Plan of Action to Combat Desertification;

2. The present report has been prepared by the United Nations Environment Programme in response to these requests. The report presents information on the status of activities as of June 1991.

II. PROGRESS REPORT BY UNEP

Mandate

3. Paragraph 6 of the United Nations General Assembly resolution 44/172 A: "... Invites the Governing Council of UNEP to contribute substantially to the discussion on desertification at the Conference, inter alia, by undertaking a general evaluation, sufficiently in advance, of the progress achieved in implementing the Plan of Action to Combat Desertification";

4. Paragraph 7 of the same resolution "... Requests the Secretary General, in consultation with the Executive Direction of UNEP, to submit to the Conference, through its Preparatory Committee, a report containing relevant expert studies on inter alia 7 topics (ref. General Assembly resolution 44/172 para. 7 a-g)".

5. The UNCED Preparatory Committee at its Second Session, in decision 1/15 under item II Desertification and Drought "... Invited UNEP to implement urgently the provisions of paragraphs 6 and 7 of General Assembly resolution 44/172 A of 10 December 1989 and 44/172 B related to the progress achieved in the implementation of the PACD";

6. The UNEP Governing Council at it's 16th session under decision 16/22 A in paragraph 8: "... Also requests the Executive Director to intensify his efforts to contribute fully to the preparations for the United Nations

Conference on Environment and Development in the area of implementing the Plan of Action to Combat Desertification and to report on his efforts to Preparatory Committee for the Conference through, inter alia, the drafting of a consolidated report to be made available to the Committee at its fourth session and giving a progress report to the Preparatory Committee at its third session, since the Committee has decided to have a full discussion of the issue of desertification at that session".

Action by UNEP

7. In response to the above UNEP is preparing a composite report on the "STATUS OF DESERTIFICATION AND IMPLEMENTATION OF THE UNITED NATIONS PLAN OF ACTION TO COMBAT DESERTIFICATION". This composite report will contain the following main components:

(1) The Executive Policy Makers summary (3-5 pp)

This executive summary will, in a condensed form, contain the following:

(i) A short introduction to the history of addressing the problem of desertification by the United Nations system and of the principal causes of failure to fully implement the PACD since UNCOD - 1977;

(ii) the main findings regarding the status of desertification in the world and its environmental, societal and economic consequences on the earth and world community;

(iii) recommendations concerning practical actions (including financing), within the scope of AGENDA-21, at national, regional and international levels required for the implementation of the United Nations Plan of Action to Combat Desertification (PACD); and

(iv) major policy guidelines and principles;

(2) World Status of Desertification (16-18 pp)

(i) **Concept of Desertification.** The concept of desertification and its definition as land degradation in arid, semi-arid and dry sub-humid areas resulting mainly from adverse human impact.

(ii) **Past Assessments 1977, 1984**

(iii) **Present Status Assessment.** Short methodological introduction; present status of desertification will be by continents and by major land-use systems in the drylands.In support to this report a **"World Atlas of Thematic Maps on Desertification"** (approx.96 A-3 pages with maps, graphs and diagrams on global regional and national/local aspects of desertification) will be published by Edward Arnolds for UNEP and be available in English early in 1992.

(3) The United Nations Plan of Action to Combat Desertification (12-15pp)

(i) **Monitoring of the PACD and its Evaluation by UNEP.** The report on External Evaluation of the Plan of Action to Combat Desertification document UNEP/GC.16/16/Add.1 of 10 December 1990), approved by 16th Governing Council of UNEP, will be annexed.

(ii) **Implementation of PACD 1978-1991;** Progress achieved in the implementation of the PACD since UNCOD-1977 by the United Nations system and the International Community. Analysis of constraints pertaining to the implementation of PACD recommendations.

(4) Proposed Agenda-21 Action on Implementation of the PACD (12-15 pp)

(i) **Policy Guidelines.** This section will describe: (i) Role and Place of Anti-desertification Measures within the Programmes for Socio-Economic Development and Protection of the Environment; (ii) General Goal of Implementing PACD, Practical Environmental/Developmental Targets for the Supporting Measures; and (iii) Main Strategic principles of implementing the PACD.

(ii) **Course of Action.** This section will contain practical recommendations for action for implementing the PACD nationally, regionally and internationally.

(5) Financing of the PACD (5-8 pp)

(i) **Desertification Costs: Land Damage and Rehabilitation.** There will be a detailed estimation of the losses, both on-site and off-site, due to desertification, direct economic and indirect social losses. The cost of corrective measures will be provided together with the evaluation of the cost of development in the drylands.

(ii) **Financing the PACD.** This section will provide (a) a summary of the past experience in financing the implementation of the PACD, e.g. the Consultative Group for Desertification Control (DESCON), Special Account, assistance by United Nations Agencies, bilateral assistance, etc., and (b) the recommendations on the mobilization of the resources. The Report of the United Nations Secretary-General on the expert studies of financing anti- desertification programmes will be annexed (ref. section 6).

Drafts of all parts of the composite report will be available by the end of July 1991. The composite report will be submitted in final draft form to the Inter-Agency Working Group on Desertification (IAWGD) and to the Consultative Group for Desertification Control (DESCON) for discussion at their next sessions in September 1991, and subsequently after finalization it will be submitted to the third Special Session of the UNEP Governing Council (3-5/2/1992) for approval and onward transmission to the United Nations General Assembly and the 4th Preparatory Committee meeting of UNCED.

(6) In response to Para. 7 of General Assembly resolution 44/172 a separate report by the Secretary-General of United Nations : "Expert Studies on Financing Anti-Desertification Programmes" is being prepared. To compile the required report the Executive Director of UNEP has convened two international expert meetings to assist in the review of the draft studies. The first meeting was convened in Geneva, 9-11 July 1990, and attended by specialists with expertise in the subject areas of the studies called for the General Assembly. Following guidelines established by this meeting, a Discussion Paper on Financing of Anti- Desertification Programmes, covering the 7 topics, was prepared with the assistance of consultants. For the second meeting convened from 21 to 23 February 1991 in Nairobi the Executive Director invited high-level international experts in the field of public finance and funding of development programmes. The detailed review of the Discussion Paper provided substantive comments on the individual studies contained in the draft. Based on these comments the secretariat has elaborated the studies by incorporating new material as recommended by the meeting. A semi-final draft was prepared in April 1991 for use as discussion paper by a high-level meeting of international finance experts at the third meeting from 10 to 12 July 1991 in Geneva. A final draft is expected to be ready by August 1991 for further comments by IAWGD and DESCON in mid September. The Executive Director of UNEP will also send it to the Secretary General of United Nations and request authorization to submit it to the Preparatory Committee of UNCED at its 3rd session. The final report will be available in October 1991.

8. In response to General Assembly Resolution 44/172 A paragraph 12 a draft report of the Secretary General on the implementation of General Assembly resolution 44/172 A was prepared and forwarded to new York for submission to the General Assembly through ECOSOC.

9. In response to General Assembly Resolution 44/172 B UNSO has and will report on its activities undertaken for the implementation of the PACD in the Sudano- Sahelian region under the UNDP/UNEP joint venture and otherwise.

ANNEX II

REVIEW OF DROUGHT MONITORING AND RESEARCH ACTIVITIES CURRENTLY BEING UNDERTAKEN BY THE AGENCIES OF THE UNITED NATIONS SYSTEM AND OTHER RELEVANT ORGANIZATIONS

I. INTRODUCTION

1. The Preparatory Committee, in its decision 1/15 on Soil Loss and Desertification and Drought, Section II, Desertification and Drought "... Requested the Secretary-General of the United Nations Conference on Environment and Development to follow closely the drought monitoring and research activities currently being undertaken by the World Meteorological Organization, the United Nations Environment Programme, the United Nations Sudano-Sahelian Office, the Food and Agriculture Organization of the United Nations and other relevant organizations, inter alia, the Sahel-Sahara Observatory and to report to the Preparatory Committee at its third session on the status of such activities and make recommendations on how the Preparatory Committee could support those very important initiatives".

2. The present report was prepared in response to the request of the Preparatory Committee.

II. REVIEW OF THE CURRENT SITUATION

Definition of drought

3. Meteorological and/or hydrological drought are seen as a factor of desertification, especially if drought conditions occur during several consecutive years leading to a drastic impact on human activity. The characteristics of these various types of drought are:

(i) Meteorological drought occurs when there is a prolonged absence or marked deficiency of precipitation. Meteorological drought is a temporary feature, caused by climate variations, observed mostly in semi-arid and sub-humid regions, but occurring also in other climatic regions.

(ii) Hydrological drought occurs when there is a sustained and regionally extensive occurrence of below average natural water availability either in the form of precipitation, river runoff, or ground water.

(iii) Agricultural drought occurs when rainfall amounts and distribution, surface and/or sub-surface water resources, soil water reserves and evaporation losses combine to cause crop or livestock yields to diminish markedly.

4. Therefore, the monitoring of meteorological and hydrological parameters is critical to evaluate desertification processes, studying the meteorological and hydrological factors needed for determining proper land management practices, preparing various climatic and drought probability maps and providing meteorological and hydrological input to anti-desertification technology.

Causes of Drought

5. The occurrence of persistent drought is primarily linked to displacements or variations in strength on time scales of a month to several years in the normally observed large-scale features of the atmospheric general circulation. These circulation variations affect the development of the local rain-producing disturbances. The causes of such circulating variations are not well understood but links with sea surface temperature and snow cover have been established. For example, correlations have been found between Sahel droughts and such large scale factors as anomalous sea surface temperature in the Atlantic and weakening of the west African monsoon.

6. A number of regional interactions between the atmosphere and the underlying surface are thought to play a part in maintaining droughts. Such feedback (" the desert feeds on itself") could result from a large increase in surface albedo, and its effect on the radiation balance, that occurs in drought conditions, and from diminished water storage, and hence reduced evaporation, over continental areas.

7. Research activities concerning the cause of droughts have been undertaken particularly in the framework of the WMO Tropical Meteorology Research Programme (TMRP). Possible causes of large scale variations of the global atmospheric circulation have been studied within the WMO/ICSU World Climate Research programme (WCRP).

8. One of the basic tools is the wealth of accumulated climatic data and data from the World Weather Watch network of operational current observation stations and satellites. Another tool is the accumulated and increasing scientific expertise, including that on advanced modelling of the atmosphere and ocean, transferred through education and training activities in meteorology, coordinated by WMO throughout the world.

9. A very important role in improving drought prediction techniques belongs to major observational research programmes such as TOGA, within the WCRP, which lay down a basis for improved monthly and seasonal forecasts in tropical regions. These forecasts, although being issued chiefly on an experimental basis, can still be used to serve agricultural, water management and other sectors. Also, information on trends (e.g. of temperature and/or precipitation) represents an essential input to long-term socio-economic planning.

Impact of drought

10. The impact of drought on agriculture, land use and degradation and water resources management, is especially visible in semi-arid and sub-humid areas. In these areas the occurrence of drought has been a phenomenon observed periodically for hundreds or thousands of years. Basically, the local plant, animal and human life has adapted itself to the occurrence of drought. In a "balanced" system, the exploitation of microclimatic opportunities maintains or even enhances their existence. There is a certain "elasticity" to accommodate a temporary change in one of the components in the supply/demand balance, be it a seasonal or annual drought or a sudden temporary increase in precipitation. Ecosystems are not able to cope, without major modifications

in their characteristics and appearance, with permanent changes in these components, such as those caused by climatic changes as opposed to climatic variability, or by a permanent increase in the animal or human population, initially sustained by outside forces. If such permanent changes occur, the function of and interaction between each component of an ecosystem need to be reassessed.

11. Until the characteristics of the general circulation and the causes of drought have been accurately assessed, one cannot say that human interference as such causes drought. It can, however, certainly change the impact of drought from a reversible and tolerable one to an irreversible and intolerable one. It is possible to decrease the adverse effects of drought by providing and using advance (forecast and climatic) or real-time information on the occurrence of drought and on the likely effects of drought.

Monitoring and assessing drought

12. A realistic monitoring of drought requires homogeneous, systematic and timely observations of meteorological and hydrological parameters, including precipitation, streamflow, radiation, temperature, wind, air humidity, evapotranspiration, soil water and subsurface water resources. Ground stations and satellites are required for these observation and monitoring processes.

Forecasting drought

13. Forecasting of drought, in contrast with assessment of the probability of drought, is not yet operationally possible, although experimentally, some statistical and dynamical forecasts have been prepared for the Sahel, North-east Brazil, the United States and Japan. It is essential for forecasting drought to predict long-term trends in the general circulation, sometimes in connection with monsoon circulations and how these affect the occurrence or rain-producing disturbances. A good historical and real time meteorological observation bases is essential for the development and operational use of future forecasting techniques. In addition, observations of SST and other non-meteorological parameters used in El Nino/Southern Oscillation studies are required.

Alleviating the effects of drought

14. Meteorological and hydrological information can be used to alleviate the effects of drought as well as its effects on microclimatic conditions and land degradation. In this connection, the following activities of the WMO Agricultural Meteorology Programme and Operational Hydrology Programme are very relevant.

15. WMO has distributed to its members a Model Drought Response Plan that can be adapted to the specific needs of each country. Such a plan can often be implemented in conjunction s with a national climate plan. The plan describes the use of meteorological and hydrological information in many potential applications adjusted according to the specific social, economic and fiscal structures in different countries. One prime requirement is the enlistment of the cooperation of the users and potential beneficiaries of meteorological and hydrological information.

16. In some countries national Meteorological Services provide needed information routinely to limited-area pilot projects to test the formulation, dissemination and used of such information. In many countries, however, this activity still needs to be started. Meteorological data are used to calculate day-to-day real water requirements in irrigated agriculture, thus assuring that crops get the right amount of water needed for optimal growth without wasting water resources, and reducing the chances of land degradation, waterlogging and salinization through over-irrigation. In this connection WMO intends to start a series of roving seminars on the efficient use of water resources in cooperation with FAO. National Meteorological Services collect and disseminate meteorological data as contributions to national and international food early warning systems, such as those operated by FAO. This helps governments take measures to rationally distribute available food resources and to take timely remedial measures.

17. Overgrazing is one of the principal causes of land degradation. This can be avoided if estimations are made as to whether the available food will be sufficient or whether the size of the herds needs to be reduced. Operational models now exist for such calculations using meteorological data. WMO organized roving seminars for staff of national meteorological and livestock husbandry services to train them on how to analyse the results of these models and to provided the technical information on the carrying capacity of pasture land based on meteorological data.

18. Land degradation through water erosion is another process contributing to desertification. One important factor affecting soil erosion in the "aggressivity" of rainfall, a combined result of certain rates of rainfall amount, intensity and duration. WMO organizes roving seminars to train staff of national Meteorological Services and soil conservation services in the analysis of rainfall observations to provided the information on rainfall aggressivity, which helps them to take erosion control measures and also to retain some the rainfall for use in irrigation and for other purposes.

19. Jointly with UNESCO, WMO has published a report on hydrological aspects of drought which covers a range of topics including the use of hydrological data in monitoring drought conditions, the impact of drought on the hydrological regime and water resources, and prospects for limiting this impact. UNSO has give emphasis to work out the national level with countries in the development of environmental information systems.

20. In this respect a framework programme for environmental information systems has been prepared by UNSO and is currently being reviewed by and discussed with concerned countries as well as with key subregional organizations such as CILSS and IGADD. This framework programme include, at the country level, the development of a policy of information compatibility, the establishment of a network and the establishment of a specialized technical unit to buttress a network.

21. These type of environmental information systems can in fact be seen as needed corollaries to the strategic frameworks for environmental and natural resources management which UNSO is helping to develop or supporting in the countries often in collaboration with CILSS and the World Bank, UNEP, IUCN and FAO.

22. Moreover, a diagnostic study and analytic inventory has recently been completed and jointly undertaken by UNSO and the Sahara Sahel Observatory Programme (OSS). This inventory will serve as the first authorized information and data base covering 20 countries i the North West and East Africa and containing information on ongoing activities related to ecological and environmental monitoring, concerned organizations, and programme goals.

Education and training activities

23. Apart from activities on education and training in meteorology and hydrology, WMO, FAO and other international and regional organizations organize specific training in techniques as described in this note and on the collection and management of data required for the use of such techniques. Such training is provided through regional workshops, roving seminars and national follow-up activities, e.g. as missions by consultants or seconded experts.

Institution building

24. Applications of information obtained through techniques mentioned in this note requires certain minimal institutional arrangements in most countries concerned. The establishment of national agrometeorological services which should collaborate closely with the user services, often through a formal or informal multidisciplinary working groups such as the institution of a partnership formula which will be included as a conceptual pilar at national level in the above-mentioned framework programme for environmental information system (UNSO, IGADD, CILSS) should be promoted.

25. In this respect, a good example of what institution building should be is given to us by the recent creation of the Sahara Sahel Observatory Programme whose objectives are as follows:

(i) To give a new impetus to combat against desertification in Africa and to favour a sustainable management of natural resources by reinforcing international cooperation in this field;

(ii) To contribute to the elaboration of evaluation methodologies of desertification;

(iii) To evolve a coherent approach of the definition of new interdisciplinary and specific actions and also to reinforce and encourage the coordination of ongoing activities;

(iv) To reinforce existing national and sub-regional structures as well as exchanges between researchers and developers from developed and developing countries; to reinforce the participation of the local populations in the elaboration of programmes which would improve the management of resources and the mastering of new technologies.

26. The role of the OSS is to liaise, monitor, exchange information, harmonize and share the expertise among North/South partners and regional and international organizations dealing with desertification control in the circum-saharan zone.

III. CONCLUSIONS

27. Drought is basically a meteorological and hydrological phenomenon. The efficiency of all human activities to alleviate the effect of drought and to combat land degradation depends partly to totally on a rapid and unequivocal assessment of the past and real-time meteorological stations in order to obtain the necessary data for monitoring and assessing drought and to further develop techniques for seasonal weather forecasts. Efforts currently being undertaken by the agencies of the United Nations system try to maintain effective networks of meteorological stations in order to obtain the necessary data for monitoring and assessing drought and to further develop techniques for seasonal weather forecasting.

28. However, it should be pointed out that while a number of actions have so far been undertaken by countries and organizations in the context of drought, the emphasis seems to have been on collection and dissemination of information on seasonal (hence short-term) developments, or early warning (rain monitoring, flood monitoring on streams, agricultural statistics, etc.).

29. Clearly much remains to be done on aspects relating to drought-preparedness although no scientific methods yet exist to reliably predict the onset, cessation or recurrence patterns of drought. Hence, a correlation with climate change tendencies needs, as underlined in our introduction, to be specifically examined and defined.

ANNEX III

EXPANDING REFORESTATION ACTIVITIES TO COMBAT LAND DEGRADATION AND DESERTIFICATION

I. INTRODUCTION

1. The Preparatory Committee, in its decision 1/15 on Soil Loss and Desertification and Drought, Section II, Desertification and Drought, requested "... the Secretary-General of the United Nations Conference on Environment and Development to prepare a comprehensive study on the ways and means of expanding reforestation activities to combat land degradation and desertification ...".

2. The present report was prepared in response to the request of the Preparatory Committee.

II. BACKGROUND

3. Soil degradation and the innumerable problems this causes for people living in or near areas subject to degradation are the products of a complex chain of factors. Likewise, there are no simple solutions which might successfully be applied alone or in a universal manner. Nevertheless there is substantial accumulated experience in afforestation and woody vegetation management which permit improving the quality of life for both rural and urban populations by partially or totally neutralizing soil degradation processes.

4. It is convenient to analyse what is understood by afforestation and the multiple ways it can contribute to arresting and reversing soil degradation processes. Traditionally, forestry and forest technology have had their major development in countries with temperate climates. These countries are oriented towards supplying woody material to transform to products such as paper or lumber. Forested areas in countries with temperate and/or cold climates have experienced slow but sustained growth of the area covered by forests and increased productivity through intensifying forest management. Most of these are public forests, although large areas are owned by big corporations with the remainder owned by farmers whose main activities are agriculture or cattle-raising, forestry being a secondary concern.

5. In tropical closed forest areas which are experiencing a tendency to decrease in terms of extent and productivity, commercial exploitation has been oriented toward export of raw materials which are processed in developing countries. There are no sustainable management models for a generalized application, and most techniques, concepts and general principles applicable to temperate and boreal zones are not valid under tropical conditions.

6. The soils most susceptible to erosion and degradation are frequently found in arid, semi-arid and sub-humid zones, where woody species including shrubs, have traditionally served as sources of fuel and construction materials for agriculture (i.e. fence-posts). Large scale timber production, the dispersion of forested areas and the characteristics of their use have determined that there is neither a research structure and technological

development nor management models equivalent to those found in boreal zones. Moreover, as the use of these forested areas cross over traditional boundaries of agriculture, cattle-raising and forestry (as understood in developed countries). The importance and possibilities of forest management and afforestation have been underestimated or ignored by both the institutions and the professionals that define their roles as relating to "forestry".

7. In practice, the contribution of forest activity in mitigating or preventing soil degradation or deterioration problems is closely linked to obtaining food security at family and national levels; to rational management of water resources; to migration, job creation and equity in the treatment of marginal groups (most notably women in developing countries). None of these subjects have been an important preoccupation of traditional forest activity, and seldom discussed in forestry schools as part of the training of future professionals. Also, consideration of these subjects has been slanted, because most of them have had no quantitative expression, measurable by a simple parameter (such as Gross National Product). The recent introduction of the sustainable development concept represents a step in the right direction, but the theoretical framework for new econometric tools is still lacking.

8. As a consequence of the above, there is a need to develop new concepts and management models which integrate subjects such as agriculture and forestry that, up to now, have been considered separately. Additionally, the contribution of the social sciences in conceiving and evaluating afforestation programs is indispensable, since their success or failure depends on the perception of and participation by, local communities, whose interests are different than those of the urban elites who propose development programmes. Even where afforestation is financially self-sustaining, local populations can be negatively affected by changes in land use or by closing access to areas previously integrated with local production cycles.

III. THE ROLE OF AFFORESTATION

9. Afforestation programs can have diverse objectives, and, in turn, multiple impacts (positive or negative) on the rural environment and society. Afforestation programs can adopt some of the following approaches:

(i) Afforestation to produce woody materials

10. This probably constitutes the most classic afforestation theme, and is what comes to mind when the term is mentioned. The purpose can be the provision of raw materials for pulp and paper industries, sawmills or other type of processing, or for providing biomass for energy production. The importance of this use has increased in the last few years. This general type of afforestation is more suited to sub-humid lands and soils with a medium degree of degradation. Trees can receive appropriate amounts of water and nutrients to allow them to grow reasonably fast (enough for an acceptable rate of return on investment) in this type of afforestation.

11. Outstanding examples can be seen in southern Brazil, southern Chile and New Zealand, where large forest industries have been established, based on woody productions from forest plantations in lands degraded by past

agricultural or grazing use and subsequently abandoned. These programs are financially viable because there are a number of opportunities in forest products exportation, even though over four-fifths of such commerce is between neighbouring countries (i.e. Canada and the United States) or within given geographical regions (i.e. Scandinavia and the European Economic Community). On the other hand, there are great production opportunities for domestic markets, especially for such products as biomass for fuel consumption.

(ii) Afforestation to introduce agroforestry practices

12. As a management practice carried out by local people in Asia, Oceania, Africa and Latin America, agroforestry is thousands of years old. Its principles are based on increasing spatial and temporal diversity of annual and perennial plant species. Such increase in diversity involves combining plantations of herbaceous and woody plants, as well as plants producing fruits, seeds, leaves or woody material. Until recently, agroforestry was ignored by developed countries and the professional establishment. It was considered a "primitive" practice destined to disappear as agriculture and forestry systems from developed countries were adopted.

13. Agroforestry can contribute to avoidance of soil loss and degradation in several ways. By creating a perennial vegetation cover with strong, extended root systems, soils are protected from the physical impact of rain and running water. If the woody species used are leguminous, the nitrifying bacteria improve soil fertility, thereby increasing its productivity and providing better livelihood conditions and increasing food security. Major soil loss is prevented, and migration toward marginal lands more susceptible to degradation is avoided.

(iii) Stemming soil degradation in selected food and fibre production practices

14. Livestock production is, potentially, one of the most destructive practices. Domestic herbivores are able to utilize plants and soils not directly suited to growing human food plants. Most domestic species are selective in their choice of forage, and as they are confined or subject to limited ranging possibilities, display a tendency to overgraze pastures at critical times, such as in times of drought or immediately after a drought period, when certain plants are under stress.

15. Human pressure in soils is usually the product of a combination of factors operating together and mutually reinforcing in their negative effect; i.e. overgrazing might be combined with fuelwood collection, leading to depletion of protective ground cover and, in extreme cases, dung collection that deprives the soils of nutrients. Afforestation for the production of fodder helps to mitigate several of these pressures; in addition to providing food for cattle through direct consumption, a better source of fuel is provided. Grass cover at ground level is improved as a result of partial shading, wind-break effects and the opportunity given to grasses and forbs to seed and propagate themselves.

16. Fodder plantations are able to store nutrients in their biomass during favourable periods of climatic cycles (e.g. during rainy seasons or the rainy part of a multi-annual cycle), maintaining them in their leaves and branches,

in a form that is acceptable to domestic herbivores even during the height of an unfavourable period. This permits a constant availability of forage that is otherwise obtainable only at high market prices or through expensive hay storage techniques.

(iv) Watershed restoration

17. Afforestation for watershed restoration purposes is practised in many countries. Degraded soils, when exposed to the impact of raindrops suffer accelerated degradation which make them totally unproductive. In respect to the effects on water yields and water table levels, soil degradation leads to floods followed by drought periods. Even though total annual flow of water remains essentially the same, soil loss leads to increased surface runoff and decreased infiltration and long term underground storage. Run-off water causes floods and less water accumulation means less water flow in streams and rivers and a lower water table. Afforestation using trees or shrubs tends to re-establish the infiltration capacity.

(v) Biodiversity preservation

18. Afforestation has a two-fold relationship with biodiversity preservation. Newly established woody vegetation may increase the populations, gene pools and survival opportunities of threatened species used for planting; it may also provide habitat for threatened species of flora or fauna, by design or by chance. On the other hand, large scale commercial schemes can increase the threat or even eradicate the whole population of species that happen to survive in the areas targeted for planting. There is another indirect relationship, where plantations provide wood resources that contribute to ease pressures formerly suffered by native forests or shrubby vegetation.

19. Afforestation plans should consider that the establishment of monocultures tend to simplify ecosystems and decrease biodiversity, unless this factor is taken explicitly into account. In such cases, rather small investments could provide significant benefits; the strategies could include planting of threatened species, leaving undisturbed vegetation patches large enough to be self-sustaining in the long run and providing raw materials in order to relieve pressures on native vegetation with valuable biodiversity. Given the importance assigned to biodiversity preservation by decision makers, voters and their elected representatives in developed countries, a steady flow of financial resources to developing countries for afforestation purposes is dependent in this factor being duly considered.

(vi) Carbon sink

20. Afforestation especially in degraded soils that have very little ground cover and, thus, a very limited above and underground biomass, is a very effective way of fixing carbon. The carbon sink role can be linked simultaneously to soil protection and to the production of fuel, industrial raw materials and fodder, although in the latter case, given the lesser accumulation of woody biomass and the periodic consumption of a large proportion of green biomass, the carbon sink function is not as efficient as in the case of plantations growing fuelwood or industrial raw materials. Forest plantations in sub-humid lands tend to accumulate biomass faster than in semi-arid or arid conditions.

(vii) Non-wood and non-consumptive uses

21. There are a number of non-consumptive ways of using lands subject to afforestation programs. One of them is wildlife management, another is tourism and recreation (other non-consumptive uses such as watershed management and grazing/browsing by domestic animals have been mentioned already). Wildlife and tourism are frequently combined and afforestation is usually integrated with other management measures in order to provide certain critical habitat or food for wildlife, or to provide certain amenities for people, such as shade or an attractive landscape.

(viii) Dune control

22. Afforestation is an effective measure for dune control, provided that precipitation is higher than 500 mm (20 inches) per year. With proper management measures guiding logging operations, dunes can be transformed into commercially productive forest lands, paying their own way and promoting soil rehabilitation. Nevertheless, when planning to solve dune encroachment problems it should be born in mind that most problems of this type occur in areas with very low rainfall, usually not enough for successful afforestation with tree species. Shrubs, with a higher resistance to drought conditions, are less attractive commercially, although they can achieve stabilization as efficiently as tree species.

(ix) Woody vegetation management

23. Although this alternative is in fact a non-afforestation measure, it is convenient to consider management of existing vegetation as a cost-effective possibility of achieving similar results without the expenditures involved in afforestation. In this case there are limitations as to species involved, to initial spacing or genetic stock, but there are a number of advantages, besides the already mentioned cost considerations. One of these advantages is related to adaptation to local conditions, another is the shorter time before harvesting. In fact, in most cases management of existing vegetation should complement afforestation efforts. This is very clear in certain special-purpose plantations, such as those aimed at providing fodder for cattle, and where afforestation covers only a faction of the total surface devoted to grazing, the majority of the area being covered by natural grasslands.

IV. OPTIONS FOR ACTION

24. Afforestation represents a useful and promising tool that may be used as a contribution to solving soil degradation problems, but there are a number of issues that should be taken into account before a successful program is launched. Besides the obvious financial constraints, other obstacles should be overcome. Large scale afforestation programs that start by setting compulsory goals and then proceed top-down, usually fail. A number of these schemes have been abandoned: there are examples in the USA, the Sahel and elsewhere, particularly the forest barrier projects aiming to "stop" encroaching deserts.

25. On the other hand, successful programs, such as those applied in Brazil and Chile, have started with much less fanfare and without setting pre-determined goals as to total area or precise location of the forest plantations. The difference has been an emphasis on removing obstacles to peasant and private business involvement in afforestation. Each participating person or enterprise takes care of the details and government agencies have a supervising role, guiding and evaluating the process, but carefully avoiding centralized decisions that foreclose the possibility of using local knowledge, experience, initiative and opportunities. By no means have these programmes been exempted of problem or criticism, especially on environmental and equity grounds, but nevertheless they have created jobs, generated a renewable natural resource base, protected degraded soils and relieved pressures soils and relieved pressures on natural forest resources.

26. There are many conditions that must be met in order to launch afforestation programs aimed at avoiding or mitigating soil loss and soil degradation. The most important factors are related to research, information and technological transfer, policy changes, and organization of field action. These conditions are briefly described below:

27. Research, information and technological transfer. Four lines of action could usefully be addressed:

(i) Knowledge about local perceptions related to forest, forest lands and natural vegetation. The same physical elements - trees, soils, wildlife - are perceived very differently by local inhabitants and development planners. If the views of local people are ignored, afforestation may meet resistance because it could be perceived as an encroachment upon lands that provide their livelihood, no matter how precarious or unsustainable it might be.

(ii) Establishment and permanent operation of soil degradation and forest cover monitoring systems, including practical early warning indicators for the identification of critical areas that require priority action.

(iii) Development of land-use models based on the improvement of local practices. Afforestation should be integrated within local patterns of land use; a good understanding of the interaction of new and old practices and the resilience of the whole ecological and social system This is a prerequisite to avoid negative impacts or programme failures.

(iv) Improvement of the information flow to politicians and other decision makers. In most countries, including those most affected by soil loss and degradation, the characteristics, shortcomings and advantages of afforestation programmes are little understood by those making development decisions. Unreasonable expectations often lead to early disappointment when results are not apparent within a few years or when precise figures for non-monetary benefits fail to be determined. Afforestation must be understood within a long-term perspective and is a complex process linked to rural development, local and national energy supply, water resources development, food security, environmental conservation and soil rehabilitation.

28. Policy changes. In most countries, forestry is in fact a non-issue, with a very low profile. No matter how important the non-financial aspects of forestry might be for a county, if there are no accompanying financial benefits, decision makers tend to ignore the losses and costs involved when no action is taken on soil loss. Various types of policy changes can be contemplated:

(i) Termination of direct and indirect subsidies that promote deforestation and soil loss. Preventive measures are much more cost-effective than remedial actions. Many countries have allied development measures that represent, in fact, subsidies to deforestation. Among them are agricultural and pasture incentives, logging concessions and road building, with no attention paid to encroachment by squatters or to the long-term ecological and financial sustainability of the activities promoted. Identification and removal of such incentives are necessary and effective steps towards solving soil loss problems.

(ii) Promotion of private participation. In the past, afforestation programmes have been heavily centralized and government operated. This reflects uncertainty and the long-term periods involved, that make them unattractive to private investors. A past general trend towards direct operation of development projects by governments is also a factor. This approach misses taking advantage of the option of enlisting the contribution of individual farmers, local organizations (such as the village land management organizations - terroirs villageois - of West Africa), and national or transnational corporations. Each one of them could make a contribution towards putting back degraded soils into food and fibre production. The private sector is very active in identifying and taking advantage of market opportunities, and this ability is crucially important since funding in concessional terms is unlikely to be abundant or generalized for afforestation or any other purpose.

(iii) Development of rural populations and employment policy using afforestation as a means to achieve long term, sustainable employment opportunities. The increase in human populations is not bad in itself, but employment and geographic location of larger numbers of human beings cannot proceed in the same way as in the past. The best agricultural land is already used and sometimes over-used, increased populations tend to spill into marginal lands that might sustain crops for a few years, at the price of soil loss and degradation. Urbanization and shifts in land use to create new job opportunities are valid and necessary responses to accommodate population growth without undue stress to the natural resource base, notably soils, or further decrease in the quality of life of rural populations. New forest-based sources of income, especially at the household and community levels, should be integrated with agriculture or other production systems, since income from forestry alone might be insufficient. This strategy spreads the risk among many sources of income.

(iv) Tax and incentive policies that will make afforestation projects more profitable by sharing the risks between the government and the private sector, postponing taxes (property and others) until the profits are realized, securing land tenure and creating vested interests in the creation and maintenance of a forest cover. There are some examples of successful incentive programmes and also a number of failures. Successful programmes seem to be dependent on the existence of afforestation management models, clear land-tenure rules, a moderately efficient government forest service (to be accountable for the public money expenditures) and a regular flow of information to decision makers, to the general public and to landowners interested in the prospect of afforesting their land.

29. Other desirable requisites include:

(i) Rural development models and experience, integrating forestry with other land uses. The options range from intensive specialized production systems, usually oriented towards overseas or urban markets, to subsistence farming, incorporating trees to act as sources of seeds, fruits, fodder, fuel or building materials. There are other options, including extensive farming/grazing/forestry systems, pluriactivity and intensive but diversified production systems. The choice of an option or a mixture of options will depend on the national and regional level of development, access to markets and local know-how and experience.

(ii) Appropriate training of technicians. Training programmes should address the relevant development issues of each country and should not rigidly follow the lines of foreign training programmes.

(iii) Institutional strengthening. Government agencies and non-government bodies must fill specialized roles in afforestation and rural development programmes. Although the trend points to less involvement of government agencies in operational details, the growing recognition of the complexities of the task and the innumerable linkages with land use, environmental and social issues, have made clear the need for efficient and well managed public bodies, able to assess, plan and direct socio-economic interventions which favour, in the first place, the least advantaged groups of society.

ANNEX IV

ALTERNATIVE AND SUSTAINABLE SYSTEMS OF PRODUCTION AND LIVELIHOODS IN MARGINAL LANDS

I. INTRODUCTION AND BACKGROUND

1. The Preparatory Committee in its decision 2/11 on Protection and Management of Land Resources:

(a) Noted with satisfaction the report of the Secretary-General of the Conference on the protection and management of land resources ... (A/CONF.151/PC/25) ... and welcomes the proposals for the development of alternative sustainable systems of production;

(b) Requested the Secretary-General of the Conference to develop these proposals in greater depth for the third session of the Preparatory Committee, paying particular attention to: (i) developmental aspects; (ii) economic and social dimensions including land tenure; (iii) resources and financial aspects; and (iv) popular participation and in particular, the participation of women;

2. The present report was prepared in response to this request putting particular emphasis on production systems in marginal lands, and in particular, arid lands. The study was conducted in collaboration and financial support by UNSO, and is available in the full length version.

3. The world's marginal lands are here defined as drylands, often subject to drought and desertification, mountain ecosystems, swamplands, and saline lands. In each of these, traditional production systems and the environments themselves have come under much stress, due to many causes including population growth, climatic fluctuations, overuse and a lack of appropriate policies of financial resources for their sustainable development. These regions have some of the highest populations in the world relative to productive resources. The population growth rates in many marginal lands are also among the world's highest, thus increasing the pressure on the natural resource base. Additionally, many drylands are experiencing a period of long-term below average rainfall, which has resulted in a decrease in natural resource productivity.

4. The results of all these changes is that current livelihood and resource use systems are not able to maintain, let alone improve, living standards in marginal areas and there is a long-term reduction of the productivity of land, water and vegetation systems. The changes have been so rapid and large-scale that modifications in traditional systems have not been able to keep pace. New strategies are needed to reduce the number of people directly dependent upon primary resource systems, and to provide them with alternative or supplementary means of livelihood.

5. Rural areas already generate wealth from activities other than subsistence production, which comprise the non-farm and off-farm sector. Few families are totally dependent upon crops and livestock for their income. It is in this context, defined by the reality of rural systems, that policy options should be explored which give greater attention to the rural "informal sector" and to the activities which link villages to regional and national economic networks.

6. Small towns are ideal locations for a range of rural industries and services as well as providing a market for poultry, vegetables, meat and other products. Larger towns are also the foci of these activities and centres of banking and financial services, and they create a bigger market for consumer goods. A well developed urban structure can promote more balanced economic development as well as help address the special needs of the rural, marginal areas.

7. This will provide a solid foundation for local resource-based, less exploitative production systems in which producers share in the economic opportunities. The capacity of the systems will be enhanced and the potential for a dynamic rural economy will be strengthened.

8. The objectives of preserving the environment, generating employment and alleviating poverty can be achieved by improving existing agricultural systems and promoting small scale enterprises. The primary emphasis of this report is on the second of these, the development of alternative and supplementary livelihood systems to reduce population pressure on land-based resources.

II. OVERVIEW OF TRADITIONAL SYSTEMS

9. The majority of the people living in dryland areas derive their livelihoods from dryland agriculture and pastoral livestock production. Both cropping and livestock systems are linked together in complex ways to minimize risk. The production systems are flexible by diversifying productive activities as opportunities arise in their wider economic sphere.

10. The success of adaptation is however constrained by population growth and by reduced and erratic rainfall, especially over the past 20 years. Thus, while demands on the resource base increasing, its capacity to provide has been declining as land degradation takes place. The demographic and climatic pressures on the dryland systems are compounded by the social and political changes in many countries, which have constrained effective policy intervention. In addition, the overall economic conditions of many countries have been declining as a result of a variety of exogenous factors, including world crop and mineral prices, debt and declining foreign investment.

11. Many of the world's poorest areas are in small, mountainous landlocked states. These systems are characterized by a diversity of micro-environments in which flat areas and terraces are under intense land use. Tree crops are often an alternative to field crops. Important constraints of the system are fragile steep slopes and related soil loss, and deforestation and limited access to markets and infrastructure.

12. Saline environments are found throughout the world. Some occur naturally, as in delta areas, and others are human-induced environments. Salinization and eutrophication are often problems, as in poorly designed irrigation systems. Some of the highest population densities in the world are found in these areas.

13. At the other end of the environmental range are the permanent and semi-permanent wetlands of the world. Where drainage, sometime linked with irrigation, has been possible some valuable agricultural lands have been added to the world's inventory, though at the expense of the wetlands environments and with the long-term problems of maintaining adequate drainage in irrigation systems. In other locations, such transformations have not been economically or physically possible. In drylands, river valleys and swamps are important dry season grazing areas though they are increasingly being cultivated.

III. IDENTIFICATION OF POSSIBLE ALTERNATIVE/SUPPLEMENTARY PRODUCTION AND LIVELIHOOD SYSTEMS

14. Successful adoption of alternative strategies depends upon people integrating them into existing livelihood systems. Rural people are both the experimenters with and potential beneficiaries of alternative systems, and they should participate fully in all phases of the process, from conception to implementation.

15. The strategies need to be socially and culturally acceptable. They will have a differential impact upon segments of society - not every strategy is appropriate for every group. The potential of individuals, households and groups to engage in them varies according to social characteristics (e.g. gender, age, vacation), economic status (availability of land, labour, capital), environmental circumstances (climate, soils) and locational factors (access to markets and infrastructure). Given the diverse environmental, economic and social conditions in marginal areas, not all strategies are applicable in all places. Nevertheless, certain promising strategies have been identified which illustrate the broad range of available alternatives.

16. Drylands separate strategies are required for cropping and herding systems. The livestock processing industry can complement herding; it generates income and employment through its multiple backward and forward linkages, similarly, wildlife-based tourism has the capacity to crate jobs and bring economic change into an area, as in Kenya, for example.

17. New crops, new processes and new enterprises are all part of a strategy for cropping systems which have potential to increase household income, through improved productivity and marketing, in an environmentally sound manner. Some dryland tree products, such as gum arabic, shea nuts and cashew nuts, have multiple local uses and can also be exported. Integration of a variety of tree crops into cropping systems in a modern way is an important strategy needing further field testing.

18. An urban handicraft enterprise which can have a positive influence in rural development areas is the manufacture of fuel-efficient stoves. Much has been learned about the design of appropriate stoves and the requirements for their successful adoption. Stove manufacture generates new employment and income in towns and cities while reducing the growth of demand for wood-based fuel.

19. Mountain. Successful interventions such as the production of high-value temperate fruit for export exist, but labour is required to maintain the resource environment, particularly in terrace systems. Given the importance of labour, animals and trees to upland agricultural systems, it is critical that strategies be available to maintain the labour resource within the mountain regions. Such employment will reduce continued pressure for land clearance to keep pace with population growth.

20. Agroforestry also has a valuable role to play in highland areas. The trees restore the availability of products lost by deforestation and reduce environmental degradation. High altitudes permit production of temperate fruit and vegetables. With an effective marketing infrastructure, these high value crops can become important exports, as in Colombia, Ethiopia and Kenya.

21. One such crop is potato. Recent advances in breeding have combined a non-edible wild potato with a conventional edible variety to produce one which is resistant to pests. This will reduce the need for pesticides. Such innovations are both environmentally sound and increase production.

22. Swamps. In swamps and irrigated areas, market gardening and pisciculture are examples of remunerative interventions. Neither food crops, livestock, fuelwood or non-extractive enterprises can alone yield a sustainable livelihood. An integrated, multiple resource system is required.

23. In sum, alternative livelihood systems in marginal lands need to have the following characteristics:

- be environmentally sound and economically sustainable;
- build upon the best mix of international scientific and local knowledge;
- be integrated with existing livelihood systems;
- galvanize the entrepreneurial spirit of local people;
- take advantage of local, regional and international opportunities;

24. Alternative systems should be facilitative not obstructive, dynamic not static, self-reliant not public dependent and self-sustaining not short-lived.

IV. ANALYSIS OF ALTERNATIVE/SUPPLEMENTARY SYSTEMS IN ECONOMIC AND ENVIRONMENTAL TERMS

25. There are three broad categories of intervention which can be integrated with existing systems. Public sector activities can complement these and contribute to conserving the environment.

26. Primary production. Increased marketing of primary product will expand income and employment. Some activities are already part of the rural system (beekeeping, poultry, market gardening wildlife/tourism) and benefits will arise from enlarging the scale and improving productivity. Others are new to the system and involve more adaptation; such strategies are less certain of success (pisciculture).

27. Processing activities. Opportunities exist in rural areas for expanding and processing products of cropping and herding systems. Such activities can maintain the value-adapted from processing in the producing areas and generate further income and employment. In some areas, success requires restructuring linkages between rural and urban systems to decentralize economic activities to market towns and villages.

28. Cottage industries. These are non-farm activities which generate substantial employment and have strong multiplier and accelerator effects. They make significant contributions to rural development by supplying basic needs (housing and clothing), promoting greater equity in income distribution and the acquisition of skills in manufacturing and management. Not all cottage industries have the same capacity to generate complementary employment and income. For example, tanneries, with extensive economic linkages between the resource system and markets, create far more opportunities than enterprises with limited linkages (agricultural implements).

29. Public investment. There is an important complementary role for the public sector, particularly in providing supportive services and infrastructure. Access to markets is vital to the success of many strategies and thus road building and maintenance is important. Activities in the defence of the environment, such as terrace and gully repair, are other public sector activities which generate substantial employment and income.

30. Economic benefits. Addressing the dual objectives of income generation and environmental sustainability implies that economic analysis must be extended beyond the study of the firm. Assessment of the economic viability of such approach needs to go beyond the returns to the farm or the firm to include the positive externalities associated with slower rates or urbanization and reduced rural land pressure and environmental degradation. Lower economies of scale can be offset by reduced external costs.

31. There are major economic benefits of small-scale activities in marginal areas, namely that job creation is less expensive than in large-scale establishments; capital is often used more efficiently; they are labour-intensive; they mobilize family savings; they generate local backward and forward linkages in product and consumption; they demand less transportation and communication infrastructure; they require less foreign exchange.

32. Alternative livelihoods and the environment. The principal environmental benefit from alternative strategies i that they allow rural systems to support a growing population by generating employment outside, but based on primary production systems. They therefore allow the direct, extractive demands on land-based resources and their related detrimental environmental consequences to be reduced.

33. Other positive implications include the fact that many use renewable resources or recycle old ones; less pollution and reduced energy consumption; many public works activities rehabilitate degraded lands (gully and terrace repair).

34. Some strategies have negative environmental implications including the fact that some deplete natural resources (wood-based enterprises) and must be integrated into a sustainable system;others incur environmental costs in terms of disposal of toxic effluents (leather) or eutrophication (irrigation).

V. OPTIONS FOR ACTION

35. The key components of a sustainable long-term economy in marginal areas are:

- special efforts to introduce new environmentally sound crops and trees to marginal systems;
- aggressive communication of new crop and tree possibilities to developing countries;
- development of agroforestry systems which have the mixed production capabilities of traditional systems but which produce higher economic returns;
- development of supplementary, environmentally sound adjuncts to agricultural systems such as fish culture and beekeeping;
- an integrated local enterprise policy which encourages small enterprise development within existing production system;
- specific support for small enterprises and new cropping strategies during the initial phase-in period;
- a marketing infrastructure which supports local production systems;
- financial systems which provide modest levels of credit for small enterprises;
- international waivers for tariffs on small volume products from marginal areas;

- government or NGO/PVO training and extension in support of small-scale enterprises and agricultural innovations;

- aggressive government policy which promotes regional growth centres and encourage local production and marketing.

36. To achieve these objectives, there needs to be a specially focused coordinated effort to evaluate the mix of activities which can help create new, viable alternative livelihood systems and to invest in the most successful of these systems in different ecological settings. Discovering what works economically and environmentally and sharing the findings with similar regions, forms the basis of a strategy for developing alternative livelihood systems for dryland marginal areas.

37. To implement the strategy proposed in this paper, the following initial steps are suggested:

- Analyse the role of small towns in marginal areas in respect to their effectiveness as market and supply nodes to their rural surroundings.

- Identify the support structure (financing, marketing, transportation and information) which improve the effectiveness of small towns as centres of rural development.

- Design and initiate pilot projects to test and introduce new strategies (trees, crops and enterprises) into different production systems. New crops and trees need rigorous testing and unbiased economic analysis which includes environmental accounting.

- Specify the support structure necessary for the successful adoption of particular strategies, including credit, training and extension.

- Initiate on a pilot basis a review of government and other pricing and finance strategies which impact on marginal areas.

- Sponsor a field based review of key successful alternative strategies and recommend where there could be replications.

- Set up mechanisms for joint public/private sector small-scale initiatives in local industrial, packaging and processing industries.

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